Emir.J.Agric.Sci.(1999),11:21-30

EXTENDING THE KHALAL STAGE OF "KHESAB"DATES USING NEW METHOD OF PACKAGING AND MODIFIED CALCIUM FORMATION.

Karim M. Farag and Hassan H. Al-Masri
United Arab Emirates University, Faculty of Agricultural Sciences, Dept. of Plant Production, Al-Ain. P.O. Box 17555

ABSTRACT

The effect of calcium chloride alone or in a formulation containing glycerol on extending the khalal stage was studied utilizing wood shavings below and above treated strands during 1997 and 1998 seasons. After cold storage, Khesab-treated fruits with $CaCl_2$ plus glycerol significantly had lower percentage of rutab fruits when compared with the control or the wood shavings treatment. An added advantage on reducing rutab development was obtained when glycerol was combined with $CaCl_2$ as compared with $CaCl_2$ alone. The absence of wood shavings in the control resulted in significantly higher rutab development when compared with the wood shavings treatment during both seasons. Electrolyte leakage of khalal fruits, as indicated by electrical conductivity, of the wood shavings treatment was significantly higher than that of $CaCl_2$ alone or in the presence of glycerol in both seasons. Moreover, Fruits embedded in wood shavings only had significantly lower electrolyte leakage than the control (without wood shavings) in both seasons at the khalal stage. This study provided evidence about the feasibility of using $CaCl_2$ plus glycerol in the presence of wood shavings to extend the khalal stage of Khesab dates and maintain their quality on a large scale.

INTRODUCTION

Date palm is an important commercial crop, especially in the Gulf area. Dates are nutritious food products with high amounts of sugars and small quantities of other nutrients (Salunkhe and Desai, 1984). There are many cultivars that could be consumed at the khalal stage such as Khesab. Since dates are generally harvested by bunch, great

amount of fruits could be harvested in a short time.Harvested Khalal fruits could rapidly develop to the rutab stage and would be fermented within few days if not dried out. Thus dates export faces the obstacle of rapid softening and deterioration. Color and texture are the most important factors determining fruit quality. Furthermore, Vinson (1924) stated that dates can not be artificially ripened into economic products before a certain minimum accumulation of sugar takes place. Thus, early harvested immature dates, like other fruits (Ryugo, 1988) with a lower sugar content would not respond to artificial ripening by ethylene-releasing compounds such as ethephon.

Attempts to extend the khalal stage of dates and to prolong their shelf life have been focussing on the use of calcium solutions whether through preharvest or postharvest treatments (Hussein et al., 1993 a,b). Calcium proved to be effective in extending the khalal stage of dates. However, placing calcium-treated fruits on the shelf or in the refrigerator at 4° C (Hussein et al., 1993b) would result in high percentage of water loss and shriveling. An applicable system is needed especially on a large scale so that date producers can adopt it to store fruits at the khalal stage and prolong it.

The objectives of this study were to increase the efficacy of calcium in extending the khalal stage by developing a new formulation, and to develop a system of packaging and storage that could be adopted by date producers without adversely affecting fruit quality of Khesab dates.

MATERIALS AND METHODS

Fruits at the khalal stage of 'Khesab' dates were obtained from Al-Oha Research Farm, United Arab Emirates University. The experiment was conducted on Oct. 6 and Sept. 29 during the two successive seasons 1997 and 1998 respectively. Fruits were uniform, free from defects, and fully colored. Strands of each season were separated from spadix of 15 bunches, mixed and randomly divided into groups, each group contained 20 strands. Any fruit with a degree of rutab development was discarded. Strands with attached fruits were washed in tap water, surface sterilized in sodium

hypochlorite (0.5%, v/v of 5% stock solution) for 3 min, then washed again in distilled water and left for air dyring.

Fruits were treated by dipping in treatment solutions for 5 min then air dried. Treatments included: water (with wood shavings); glycerol (1%, v/v); calcium chloride (2%, v/v); calcium chloride (2%, v/v) plus glycerol (1%, v/v), and finally water (control without wood shavings).

A system was developed in this study (Fig. 1) where a layer of wood shavings (small flakes) was at the bottom and the top of the treated strands (about 2 cm thick). Used wood shavings was wetted with the same treatment solution that has been used to treat fruits to prolong the uptake of solutions and to reduce exposure to the cold air in the cold chamber. Wood shavings treatment meant treating them with water only.A diagram for the used system is shown in Fig.1.

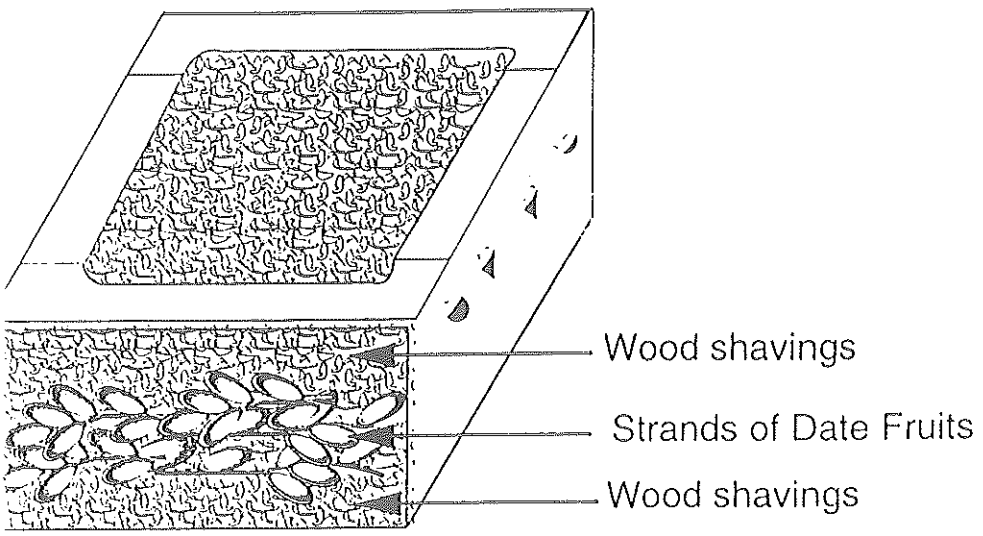

Fig 1. The developed system to prolong the uptake of treatment solution and to reduce air movement around fruits during cold storage of date.Note that date strands are embedded between two layers of small pieces of wood shavings.

The system was set up in thick carton boxes lined with plastic sheets and provided with side holes for ventilation. Boxes were left for 2 days at room temperature for drying (22±2° C), then stored at 4° C and 75% relative humidity for 35 days in a cold chamber. At the end of cold storage, the following parameters were determined in 100 g of random sample from each replication: total soluble solids (%) using hand refractometeer, juice acidity by the titration against NaOH 0.01 N (A.O.A.C., 1984), percentage of electrolyte leakage as a measure of cell membrane integrity by using electrical conductivity meter (Zhang and Willson, 1987) for fruits at the khalal and rutab stages. Percentage of rutab and khalal fruits were calculated for each replication by weight. Four replications were used with each treatment in a completely randomized design. The least significant difference (LSD at 0.05) and analysis of variance were calculated using SAS computer program (SAS, 1982).

RESULTS AND DISCUSSION

The data in Table 1 indicated that TSS trend of results after cold storage was consistent for the two seasons.During 1997, calcium-treated fruits alone or in a combination with glycerol had similar TSS to the wood shavings treatment. However, these two treatments resulted in significantly lower TSS than the control in the presence of wood shavings. Similar trend was obtained during 1998 season. There was no difference between fruits treated with calcium chloride alone or in the presence of glycerol. Moreover, glycerol-treated fruits had similar TSS to both calcium treatments during the two seasons after cold storage. The control fruits had significantly higher TSS than the wood shavings treatment in both seasons.

With regard to fruit acidity (Table 1), the data showed that changes were not consistent between the two seasons. The formulation of $CaCl_2$ plus glycerol had significantly lower acidity wood shavings treatment in the first season but not in the second. Acidity was similar for glycerol and $CaCl_2$-treated fruits in both seasons. The presence or absence of wood shavings did not have an influence on fruit acidity which was low at this stage after cold storage.

Electrical conductivity after cold storage, as an indicator to cell membrane integrity, was not significantly different between the wood shavings treatment only and calcium-treated fruits of the khalal stage in both seasons (Table 1). However, electrolyte leakage of the wood shavings treatment was significantly higher than that of calcium-treated fruits in both seasons. Furthermore, $CaCl_2$ alone resulted in similar leakage of electrolytes to that of $CaCl_2$ plus glycerol in both seasons after cold storage. Fruits with wood shavings only had significantly lower electrolyte leakage than that of the control fruits (without wood shavings) in both seasons at the khalal stage. Electrical conductivity of rutab fruits after cold storage was higher than that of the khalal stage. Control fruits without wood shavings tended to have higher electrical conductivity than those fruits with wood shavings only. Calcium chloride-treated fruits alone or in the presence of glycerol were not statistically different in their electrolyte leakage at the rutab stage in both seasons.

Data on percentage of rutab fruits after cold storage is presented in Figure 2. Trend of the results during both seasons was consistent where the lowest percentage of rutab fruits at both seasons was obtained with $CaCl_2$ plus glycerol formulation. This combination resulted in significantly lower rutab percentage of fruits when compared with the control or wood shavings treatment during both seasons. The addition of glycerol to $CaCl_2$ resulted in reduced percentage of rutab fruits as compared with glycerol or calcium chloride alone. The absence of the wood shavings in the control resulted in significantly higher rutab development when compared with fruits that were embedded in the wood shavings during both seasons (Fig. 2). Even glycerol-treated fruits tended to have lower percentage of rutab fruits than the control especially in the first season.

This study indicated to the possibility of using a large scale system that could be adopted by date growers to extend the khalal stage of fruits. Wood shavings in the form of small flakes are smooth, not expensive, and available all the year around. The system is easy to set up by date producers. This kind of wood shavings proved to be useful in prolonging the period of uptake of different solutions and in reducing air movement around the dates. The control fruits progressed faster toward ripening than that with the

wood shavings as the TSS values indicated (Table 1). Cell membrane integrity was significantly better with fruits embedded in wood shavings than the control without wood shavings after cold storage at the khalal stage. Even for rutab fruits after cold storage, electrolyte leakage of fruits with wood shavings tended to have lower electrolyte leakage than control fruits without wood shavings. These data were reflected on the percentage of rutab fruits after cold storage where control fruits had higher percentage of rutab development in the absence of the wood shavings as compared with those fruits with the wood shavings only.

The data also proved that the incorporation of glycerol with calcium solution enhanced the effectiveness of calcium in retarding the development of the rutab stage. Moreover, both calcium solutions in this study were effective in prolonging the khalal stage of Khesab dates as compared with the control or glycerol. This finding agreed with Hussein et al., 1993 a, b in their study on Zaghloul dates.

The role of calcium in extending the storage life of fruits and retarding the loss of firmness was evident in many fruits (Tomala et al., 1997; YongHua and Yh, 1995). Postharvest use of surfactants such as Brij 30, Tween 20, Tween 80, and Triton X-100 along with calcium proved to alter the fruit epicuticular wax which increase water loss and shrivelling (Roy et al., 1996). Thus, it was better for tissue integrity in our study to use glycerol. The role of calcium in maintaining tissue integrity in this study as also supported by the finding of Park et al., (1996) where calcium-treated fruits kept the middle lamella in their cell walls, while it was degenerated in the control. Retarding fruit deterioration and enhancing the shelf life by $CaCl_2$ was also supported by other studies (Sutharalingam, 1996; Bhanja and Lenka, 1994; Chukwu, et al., 1995; Zambrano and Manzano, 1995).

This study provided information about the feasibility of using such system that could be adopted by date producers on a large scale to extend the khalal stage of dates.

REFERENCES

A.O.A.C. Association of Official Analytical Chemists. 1984. Edited by S. Williams. Association of Official Analytical.

Bhanja, P.K. and Lenka, P.C.1994.Effect of pre-postharvest treatments on storage life of sapota fruits cv. Oval. Orissa Journal of Horticulture.
22: 54-57.

Chunkwu, E.W.; Olorunda, A.O.; and Ferris, R.S.B. 1995. Extension of ripening period of Muza fruit usinf calcium chloride infiltration, Semperfresh, and Brilloshine coating. MusAfrica. 8: 14-15.

Hussein, M.A.; Mahmoud, H.M.; Amin, K.A.; and Moustafa, A. 1993 a. Physiological studies for extending khalal stage of Zaghloul dates during storage. A. Effect of preharvest applications of calcium chloride. Proceeding of the Third Symposium on Date Palm in Saudi Arabia. D4.

Hussein, M.A.; Mahmoud, H.M.; Amin, K.A.; and Moustafa, A. 1993 b. Physiological studies for extending khalal stage of Zaghloul dates during storage. C. Effect of postharvest dipping in calcium chloride. Proceeding of the Third Symposium on Date Palm in Saudi Arabia. D5. P.107.

Park, S.; Lee, C.; Park, S.H.; Lee, C.U. 1996. Effect of postharvest calcium infiltration on firmness, pectin content and occurrence of *Botryosphaeria dothidea* in apple fruits. Journal of the Korean Soc. Hort. Sci. 37: 81-86.

Roy, S.; Conway, W.S.; Buta, J.G.; Watada, A.E.; Sims, C.E.; and Wergin, W.P. 1996. Surfactants affect calcium uptake from postharvest treatment of 'Golden Delicious' apples. Journal of the Amer. Soc. Hort. Sci. 121: 1179-1184.

Ryugo, K. 1988. Fruit Culture: Its Science and Art. Ed. Kay Ryugo, Univ. of California, Davis. Johan Wiley&Sons. USA. PP 344.

Salunkhe, D.K. and Desai, B.B. 1984. Postharvest Biotechnology of Fruits. Vol. II. CRC Press, Inc. USA. pp. 147.

SAS. Institute. 1982. SAS User's Guide and SAS Statistical Procedures.SAS Inst. Gary N.C.

Sutharalingam, S. 1996. Postharvest treatment of mango with calcium chloride. Tropical Science. 36: 14-17.

Tomala, K.; Val, J.; Montanes, L.; and Monge, E. 1997. Effects of calcium sprays on storage quality of 'Sampion' apples. Acta Horticulturae. 448: 59-65.

Vinson, A.E. 1924. The chemistry of the date. Date Grow. Inst. 1,11.

YongHue, M.U.; Yh, M.H. 1995. The role of calcium in fruit and vegetable physiology. Acta Horticulturae. 6: 499-501.

Zambrano, J. and Manzano, J. 1995. Effect of postharvest calcium application on mango ripening and storage. Fruits-Paris.2: 145-152.

Zang, M.I.N. and Willison, J.H.M. 1987. An improved conductivity method for the measurement of frost hardiness. Can. J. Bot. 65: 710-715.

Table 1. Fruit quality of 'Khesab' dates after cold storage as influenced by calcium formulation and the packaging system during 1997 and 1998 seasons.

Treatment	TSS (%)		Acidity (%)		EC of Khalal (%)		EC of Rutab (%)	
	1997	1998	1997	1998	1997	1998	1997	1998
wood shavings	32.13[b*]	34.13b	0.18a	0.07b	10.00b	12.32b	42.69b	31.65c
Glycerol	32.00b	33.00b	0.14bc	0.10a	10.71b	16.51ab	64.20a	32.96c
$CaCl_2$	36.25b	34.88b	0.14bc	0.10a	13.19b	21.62ab	63.89a	47.41a
$CaCl_2$+glycerol	33.75b	35.63b	0.15b	0.07b	13.27b	21.45ab	60.95a	44.67ab
Control (without wood shavings)	41.25a	39.33a	0.12c	0.09a	21.76a	22.93a	44.43b	40.23b

* Values in a column followed by the same letter are not significantly different at the 0.05 level.

Initial values for khalal fruits were: 35.00% and 30.83% for TSS; 0.28% and 0.21% for acidity percentage; 11.69 and 12.82 for EC in the Two seasons respectively.

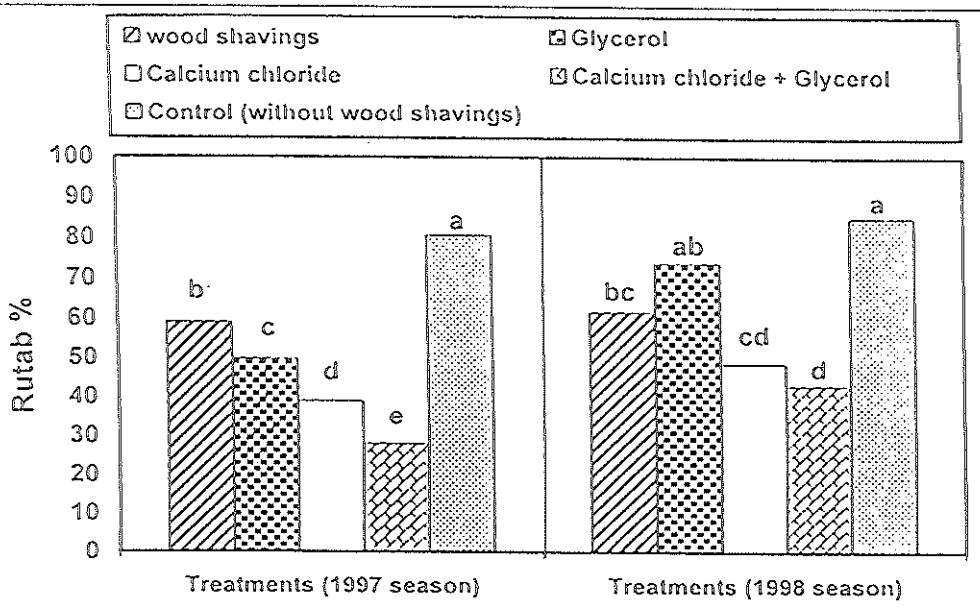

Fig. 2. Rutab percentage of Khesab dates after cold strorage as influenced by calcium formulation under the used system conditions during 1997 and 1998 seasons