Accelerated ripening of var. Aseel dates fruit using sodium chloride and acetic acid solutions

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ABSTRACT

Pakistan is rated among the top dates producing countries. The ripening and harvesting time of var. Aseel which is the predominant variety of district Khairpur is often coincides with Monsoon rains that deteriorating most of the crop either the fruit while on tree or on mats for sun drying. Due to this fear growers harvested the fruit at khalal stage and make Chuhharas (boiled date fruit at khalal stage) that has less commercial value than tamar fruits exporting worldwide. Instead of making Chuhharas, artificial ripening of var. Aseel fruit was accelerated by using sodium chloride (NaCl) and acetic acid (CH_3COOH) solutions to treat the early harvested and unripe fruit to reach tamer stage by skipping rutab stage. In current study, the harvested fruit at Khalal stage were dipped in different concentrations of both solutions for 4-5 minutes at room temperature. The collected fruit were spread out in a single layer on stainless steel trays for sun curing. Physical and chemical characters were measured before dipping treatments in both solutions and after 72 and 120 hours of sun curing. The obtained results showed the cured fruit dipped in 2% sodium chloride (T_4) was found to possess high amount of pulp and total soluble solids. It also hold large size & weight and furnish high yield of very appealing organoleptic qualities.

Keywords: Accelerated ripening, sodium chloride, Aseel dates, acetic acid.

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) is an important horticultural crop and cultivated in the warmer regions of the world mainly concentrated in Muslim countries like Egypt, Iran, Saudi Arabia, Pakistan, UAE, Oman and Libya. Date fruits being sweet and most nutritious supplying 2500-3000 Calories/kg (Amin, 2007) consumed as a staple food because the sugar content of ripe dates is about 80%; the remainder consists of protein, fat and mineral products including copper, sulphur, iron, magnesium and fluoric acid. Dates are high in fiber and an excellent source of potassium.

Date occupies third position after citrus and mango in terms of fruit area and production in Pakistan (Khushk *et al.,* 2009). The export of dates is mainly occurring from Khairpur and Turbat districts of Pakistan. There is a big gap between production and export figures. Pakistan on an average export 10-15 % of dates production and 85-90 % crop production is either consumed locally or wasted (Jatoi *et al.,* 2009).

The Aseel variety is a semi-dry and most important commercial variety of Pakistan mainly found in Khairpur district (Fig. 1). It with suitable fruit size (4.3 cm in length and 2.5 cm in diameter) consumed at rutab (Dang) and tamar (dates) stages (Markhand *et al.,* 2010; Mahar, 2007).

Each year, monsoon clashes with the dates ripening season at Khairpur and a few hours of rain may wipes out crop because rain water percolates inside the fruit bunch if fruit still on tree ready for harvest or on mats for drying (Fig. 2)

gets fermented and total losses may rise to as high as 50% (Saleem, 2004; Saleem *et al.,* 2005). To avoid unexpected risks during monsoon rains, growers are compelled to process un-ripened and non-edible var. Aseel fruit into low-priced 'chuhharas' before the start of monsoon season. The use of centuries-old unhygienic practices and hesitation in using modern techniques deteriorates the product quality, slow the growth of export and badly affects the growers' income. Such practices further contribute towards 20% to 30% post-harvest losses each year.

In order to avert such heavy losses resulting from the natural calamities and produce high quality product, present study was conducting to explore ways and means to ripe/cure var. Aseel dates artificially by using sodium chloride and acetic acid solution. Farahnaky et al. (2009) found that harvesting var. Kabkab dates at the Khalal stage followed by a short-time dipping of the fruits in NaCl or acetic acid solutions and an incubation stage of about 48-72 hours at 40°C is a promising method for controlled ripening of date fruits. This specific procedure accelerates ripening of the date fruits from khalal to tamar stages to over three days instead of weeks of natural ripening process on the tree.

MATERIALS AND METHODS

The research work has been conducted at Date Palm Research Institute, SALU, Khairpur. Healthy and uniform var. Aseel fruits were collected from commercial date palm orchard in Khairpur (Northern Sindh) at the khalal stage in July 2012. The selected dates were wiped with moist clean cloth to remove the dust. Then, they were picked out and randomly distributed into 13 batches (one kilogram each) and given preliminary treatments of NaCl and acetic acid (Fig. 3). The codes and composition of the treatments are given in Table 1.

The samples were immersed in the respective solutions (one liter) for 4-5 minutes at room temperature, allowed to drain and then spread out separately on stainless steel trays for dehydration under sun shine.

Data Collection

Physical and chemical characteristics were monitored before experiment at khalal stage (Table 2) and after 72 and 120 hours (Table 3, 4 & 5). Moisture content, pH and total soluble solids (brix) were quantitatively determined according to AOAC methods. Color and texture were observed and recorded after 72 and 120 hours.

Statistical analysis

The treatments were performed using a completely randomized design and all experiments were carried out in five replicates. The experimental data were subjected to analysis of variance followed by a multiple range Duncan's test. Significance was defined at P = 0.05. The SPSS (developer, 13) program was used for all statistical analysis.

RESULTS AND DISCUSSIONS

The efficacy of sodium chloride and acetic acid for initiation/acceleration of ripening of var. Aseel dates has been investigated. Each treatment was applied individually and in combined form at different proportions varying from 0.25 to 3.5% and 0.25 to 2.5% for sodium chloride and acetic acid respectively. Var. Aseel dates harvested at the khalal stage were immersed in solutions for 4-5 minutes and allowed to ripen/cure for 72 and 120 hours in sun shine for dehydration. Observing changes in color shade, fruit weight, pulp, texture, total soluble solids, appearance and the extent of the ripening assessed the efficiency of the treatment. All of the treatments whether applied as a single treatment or in combined form, tend to induce ripening by causing changes in the selected quality parameters.

Physical characteristics

The results indicated that harvesting var. Aseel fruits at the khalal stage followed by a short-time dipping in NaCl or acetic acid solutions at incubation period 72 and 120 hours is a promising method for controlled accelerated ripening of date fruits. This specific procedure accelerated ripening of the date fruits from khalal to tamar stages within 3 - 5 days instead of weeks by traditional sun curing method.

The data presented in table 3 in comparison with table 2 shows that the fruit and pulp weight dramatically decreased from khalal to tamar stage at 72 and 120 hours incubation period. The highest fruit weight recorded on T_{13} (6.98 g) followed by T_4 (6.86 g) and T_2 (6.46 g) at 72 hours while lowest was observed at 120 hours incubation period on T_{11}. The highest pulp weight was noted on T_{13} (6.22 g) followed by T_4 (5.86 g) and T_7 (5.76 g) at 72 hours, while lowest on T_1 (3.14 g) at 120 hours. The highest seed weight was recorded on T_4 (1.24 g) followed by T_5 & T_6 (1.1 g) and T_1 (1.06 g) at 72 hours, while lowest on T_{10} (0.64 g) at 120 hours. The maximum length was recorded on T_4 (3.82 cm) followed by T_3 & T_6 (3.22 cm) and T_9 (3.2 cm) while lowest on T_1 (2.70 cm) at 120 hours. The maximum fruit width was observed on T_4 (1.84 cm) followed by T_8 (1.64 cm) and T_7 (1.62 cm) at 72 hours, while lowest on T_{11} (1.30 cm) at 120 hours incubation period.

Generally, salt treated fruits responded well in all physical parameters of var. Aseel when used alone or in combination with acetic acid than control and acetic acid alone. Actually, fruits treated with NaCl does not undergo at dung (rutab) stage hence saving the 2 weeks' time period as compared to traditional sun drying method. These results are in agreement with the findings of Saleem

(2005) who used NaCl and acetic acid solution for the accelerated ripening of Dhakki date fruits and found NaCl better than other control and acetic acid treatments.

Chemical Characteristics

The data presented in table 4 clearly indicating that the moisture content of the date samples reduced during incubation from khalal to tamar at 72 and 120 hours' time period. The highest moisture content was recorded on T_{13} (85.00%) followed by $T_{10} - T_{12}$ (81.00%) at 72 hours, while lowest on T_2 (15.00%) at 120 hours incubation period. Ali (1989) studied the effect of hot solutions on the curing of dates and concluded that the fruit undergoing storing lost its weight through moisture evaporation.

One of the important parameters determining the microbial stability and hence the shelf life of date fruits is their pH. The highest pH value was recorded on T_5 (7.10) followed by T_5 (7.03) and T_9 (6.92) while lowest on T_4 (4.10) at 120 hours incubation period.

The highest amount of TSS was recorded on T_8 & T_{10} (4.90) followed by T_5 & T_{11} (4.10) at 120 hours, while lowest on T_1, T_3, T_8 and T_9 (2.10) at 72 hours incubation period.

Color and Texture characteristics

The results presented in table 5 showing the color and texture of fruit at 72 and 120 hours of curing. The color of fruit plays a pivotal role in the marketing value and quality index. Similarly variation in the color is closely associated with ripening of fruit (Farahnaky *et al.,* 2009). All the treatments exerted a positive effect on the color and texture of fruit. However both the characters varied with the nature of treatment applied (table 5). The amber color with attraction and shinning was recorded in T_4 with soft and very loose texture of fruit. This color and texture was considered the best in the produced lot of colors and texture. Amber color was also developed by some other treatments like T_1, T_{10} and T_{11} but it wasn't attractive and shinning. These findings are in agreement with the results on Dhakki dates by Saleem et al. (2005).

In current study time for incubation after dipping treatment in the tested solutions was increased up to 120 hours as the results obtained by Farahnaky et al. (2009) reported that harvested dates fruit of var. Kabkab at the Khalal stage followed by a short-time dipping of the fruits in NaCl or acetic acid solutions and an incubation stage of about 48-72 hours at 40°C is a promising method for controlled ripening of date fruits. The same findings have been produced by Saleem et al. (2005) while working on Dhakki dates in Pakistan. On the contrary, current study results indicated that 120 hours treatment proved better than the 72 hours treatment for var. Aseel. The difference in curing time from 72hours for Kabkab and Dhakki and 120 hours for var. Aseel could be because of varietal difference.

CONCLUSIONS

It can be concluded from the results obtained that sodium chloride and acetic acid exerted a positive response on ripening of var. Aseel dates by accelerated curing process. Using, 2% sodium chloride proved more effective in terms of fruit weight, pulp contents, color, texture, taste and appearance (Fig. 4). It proves beyond doubt that leaving the fruit on the tree to get dung (Rutab) formation through natural process is not justified that taken at least six weeks for the conversion of fruit from khalal to tamer stages. Whereas, the same process of conversion has been accelerated by artificial means through bypassing the Rutab stage within 120 hours using NaCl and acetic acid solutions. Hence, suggested a possible solution against making low price chuhhara by skipping the fear of monsoon rains by accelerating the ripening process of var. Aseel dates.

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Tables

Table 1. The abbreviations and composition of different treatments used in the study.

Treatment	Solution composition
T_1	Water (control)
T_2	0.25%NaCl
T_3	1.50%NaCl
T_4	2.00% NaCl
T_5	3.50%NaCl
T_6	0.25%CH3COOH
T_7	0.50% CH3COOH
T_8	1.50% CH3COOH
T_9	2.50% CH3COOH
T_{10}	2.00%NaCl+0.25%CH3COOH
T_{11}	2.00%NaCl+0.50%CH3COOH
T_{12}	0.25NaCl+1.50% CH3COOH
T_{13}	2.00%NaCl+2.50%CH3COOH

Table 2. Physical and chemical characteristics of var. Aseel fruits at khalal stage before treatments.

Color	Texture	Length (cm)	Width (cm)	Fruit wt (gm)	Pulp wt (gm)	Seed wt (gm)	T.S.S	pH	Moisture (%)
Yellow	firm	3.56	2.34	11.76	9.86	1.90	2.00	6.9	86

Table 3. Effect of sodium chloride and acetic acid treatments for 72 and 120 hours on the physical characteristics of var. Aseel dates fruit.

Treatments	72 (hours)					120 (hours)				
	Fruit weight (g)	Fruit Length (cm)	Fruit Width (cm)	Pulp weight (g)	Seed weight (g)	Fruit weight (g)	Fruit Length (cm)	Fruit Width (cm)	Pulp weight (g)	Seed weight (g)
T_1 (control)	6.12	2.84	1.48	4.88	1.06	4.18	2.70	1.46	3.14	0.78
T_2	6.46	3.08	1.58	5.50	0.96	4.84	2.98	1.44	3.66	0.90
T_3	6.16	3.22	1.54	5.30	1.02	4.18	2.76	1.39	3.54	0.80
T_4	6.86	3.82	1.84	5.86	1.24	5.24	3.06	1.50	4.36	0.88
T_5	5.46	3.08	1.58	4.52	1.1	5.22	3.06	1.44	4.28	0.92
T_6	5.36	3.22	1.38	4.58	1.1	4.96	3	1.42	3.68	0.80
T_7	6.56	2.84	1.62	5.76	0.80	4.56	2.92	1.44	3.60	0.84

Treatments	72 (hours)					120 (hours)				
	Fruit weight (g)	Fruit Length (cm)	Fruit Width (cm)	Pulp weight (g)	Seed weight (g)	Fruit weight (g)	Fruit Length (cm)	Fruit Width (cm)	Pulp weight (g)	Seed weight (g)
T_8	6.42	3.00	1.64	5.6	0.80	4.76	2.94	1.50	3.88	0.96
T_9	6.42	3.2	1.54	5.60	0.82	4.72	2.88	1.34	3.92	0.80
T_{10}	6.56	3.2	1.50	5.74	0.76	4.32	2.76	1.34	3.56	0.64
T_{11}	5.08	3.16	1.50	4.38	0.70	3.62	2.84	1.30	3.40	0.88
T_{12}	6.12	3.16	1.6	4.98	0.78	4.94	3	1.56	4.12	0.74
T_{13}	6.98	3.04	1.62	6.22	0.76	4.84	2.88	1.52	4.08	1.3
LSD at 0.05	1.26	0.36	0.36	1.18	0.43	1.77	0.40	0.75	1.77	0.16

Table 4.Effect of sodium chloride and acetic acid treatments for 72 and 120 hours on the chemical characteristics of the var. Aseel dates fruit.

Treatments	72 (hours)			120 (hours)		
	Moisture%	pH	T.S.S	Moisture%	pH	T.S.S
T_1 (control)	72.60	6.80	2.10	16.00	6.55	3.80
T_2	74.30	6.30	3.20	15.00	6.09	3.70
T_3	66.00	6.40	2.10	17.00	6.84	3.80
T_4	66.00	6.60	3.20	16.00	4.10	4.00
T_5	60.00	6.51	2.50	16.00	7.10	4.10
T_6	65.00	6.80	2.20	16.00	7.03	2.50
T_7	65.00	6.70	2.50	16.00	6.84	3.50
T_8	71.60	6.50	2.10	16.00	6.65	4.90
T_9	70.00	6.40	2.10	18.00	6.92	3.90
T_{10}	81.00	6.80	2.20	16.00	6.65	4.90
T_{11}	81.00	6.00	2.60	16.00	6.84	4.10
T_{12}	81.00	6.80	2.20	18.00	6.70	3.50
T_{13}	85.00	6.80	2.10	24.00	6.60	3.70
LSD at 0.05	1.41	0.13	0.22	1.60	0.15	0.09

Table 5. Effect of sodium chloride and acetic acid treatments for 72 and 120 hours on the color and texture of the var. Aseel dates fruit.

Treatments	72 (hours)		120 (hours)	
	color	texture	color	texture
T_1 (control)	Amber color	Less soft, loose	Amber color	Less soft, loose
T_2	Amber color with attraction	Soft, pulpy, loose	Brownish color	Soft, loose
T_3	Brownish brown color but not attractive	Soft, pulpy	Brownish brown color with attraction	Soft, loose
T_4	Amber color	Soft, very loose	Amber and attractive color with shining	Soft, very loose
T_5	Reddish brown color with much attraction	Soft, loose	Brown color with attraction	Soft, loose
T_6	Brown color but not attractive	Soft, pulpy	Dark brown color	Soft, loose
T_7	Brown color but not attractive	Soft, loose	Dark brown color	Soft, loose
T_8	Dark brown color	Soft, loose	Dark brown color	Soft, very loose
T_9	Dark brown color but not shining	Soft, very loose	Dark brown color	very loose
T_{10}	Amber color	Soft, loose	Amber color	Soft, very loose
T_{11}	Amber color	Soft, loose	Amber color	Soft, very loose
T_{12}	Dark brown color	Soft, very loose	Dark brown color	Soft, very loose
T_{13}	Dark brown color	Soft, very loose	Dark brown color	Soft, very loose

Figures

Fig. 1. Var. Aseel tree with fruit at Khalal stage

Fig. 2. Monsoon rains damages the var. Aseel fruit over mats for sun drying

Fig. 3. var. Aseel fruits treated with 13 different treatments of NaCl and acetic acid

Fig. 4. Var. Aseel fruits treated with NaCl showing best accelerating ripening product