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Influence of Hot Water on Ripening/Curing of Dhakki Dates

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Abstract: The influence of hot water treatment on the ripening/curing of Dhakki dates is studied. In the first part of the experiment, the time of dipping in hot water is fixed to 5 min and temperature of the hot water varied for 35, 70 and 93°C. For the next set of the experiment the dipping time varied for 1, 3, 5, or 7 min while the temperature for the dip in hot water retained constant at 70°C, besides carrying out a simple water wash treatment to conceive absolute advantage of the hot water dip treatment. The treated samples are then allowed to ripen/cure for 72 h under air circulated cabinet dehydrator adjusted at 38-40°C. The effectiveness of the treatments is evaluated by assessing texture, taste and overall acceptability of the products, determining also the degree of fruit ripeness. The treatment with 70°C performed better than 35 and 93°C furnishing with 55% product yield of acceptable quality. The yield of improved quality product is further increased to 70% on the optimization of treatment time to 3 min. The ripening of Dhakki dates does not require the fruits to stay on tree beyond fully mature doka stage for want of dong formation and hence saves at least 2 weeks hang-on period. By implementation of the technology it is highly likely to cut down the overall expected losses and expenses considerably, besides improving quality and yield of the product reasonably.

Key words: Dhakki dates, hot water, ripening

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) is under cultivation from the time immemorial and since then it is playing an important role in the history of mankind. There are 20 verses in the Holy Qura'an in which importance of this tree has been indicated. The high nutritional status of dates is due to its nutritional worth^[1-3]. It supplies 2500-3000 calories kg⁻¹ of physiological energy, contains salts of important mineral elements like potassium, calcium, phosphorous and iron metals and possesses pro-vitamin A, vitamin B complex, niacin and vitamin C and hence promotes blood formation. Moreover, it is free from undesired cholesterol and sodium elements. It also contributes a large amount of cellulose and hemi-cellulose materials, which increase volume of stool and control constipation and are necessary for the regulation of intestinal motility. Further, the dates contain overall highest percentage of carbohydrates including glucose and fructose, which being easily digestible and water-soluble provide instant energy, that's is why the date is considered as 1st 'Iftar' diet for breaking the daily 'fast'.

The dates are one of our important cash crops and a good source of foreign exchange earnings. According to

FAO^[4], Pakistan is at fourth place amongst the largest date producing countries world over contributing about 11% of total world production. The total cultivated area of all type of dates in the country exceeds 78.1 thousand hectares with its estimated annual production over 630 thousand tonnes^[5]. Cultivation of dates in NWFP is over 1000 ha with 6700 tonne production^[6] and Dera Ismail Khan Division contributes more than 50% of the total province share. A locally developed Dhakki date variety, for being originated in village Dhakki about 50 km towards north of Dera Ismail Khan City is cultivated on commercial scale. The date is quite popular for its large size (4-5 cm long and 2-3 cm thick) and high fruit weight (16-20 g) with fine texture and delighted taste^[7] and hence fetches a high price in the market. Unfortunately, the monsoon season falls within the ripening season of Dhakki dates in the month of August. Moreover, the commissioning of CRBC makes the climate of D.I. Khan even more harsh and unpredictable. Due to persistent rainy and stormy condition the date crop receives heavy damages. Besides, the date during this period is at eatable stage (Doka/Dong) and prone to infestation by insects and diseases that flourish at a rapid rate under favourable climate of relatively reduced temperature. Moreover, date

production in overall is at a peak causing a large quantity of the freshly ripened fruits exceeding need of local consumption as surplus. As a result the local market becomes over glutted and a significant amount of the product is wasted. The cumulative losses cannot substantially be reduced due to having little appropriate storage and transportation facilities as well as lacking in preservation technology. Under the prevailing detrimental conditions the Dhakki date in particular is inflicted with heavy crop losses. In order to get some return and reduce losses the growers try to sell some of their produce while at the stage of "Doka". However, it is not much feasible in case of the Dhakki variety as the fruit at this stage is stringent in taste and does not fetch reasonable money.

The ripen fruits are cured and dried using traditional method by keeping them spread on mats under the sun in open air. However, the product becomes highly contaminated and non-uniform with low yield and is very poor in quality. Moreover, some of the produce gets fermented on drying due to rainy and cloudy atmosphere persisting longer and the total losses may rise to as high as 50%. Thus growers and country at large suffer adversely. The growers are becoming disheartened and consequently getting sluggish to further propagation of the Dhakki variety. In order to avert such heavy financial losses resulting from the natural calamities it is therefore, desired to explore ways and means to ripe/cure Dhakki dates artificially. Previously we have reported microwave radiation^[8,9] and salt and acetic acid^[10] as the added facilities to accelerate ripening/curing prior to artificial drying of Dhakki dates. In this study the use of hot water treatment for quick advancing the ripening/curing and drying processes of dates is reported.

MATERIALS AND METHODS

Dhakki fruits were collected at maturity prior to onset of Dong formation with 250 hardness (mm Hg cm⁻²). Healthy and non-infected fruits were sorted out and brought to the research laboratory of the Department of Food Science and Technology, Gomal University for experimentation. The following treatments were applied with the aim to yield a uniform and accelerated ripening and proper curing of the fruits by means of hot water treatment.

Hot water treatments: In one set of the experiment the samples were dipped in hot water (1 kg L⁻¹) at temperature of 35, 70 or 93°C for a fixed time of 5 min so as to find out the appropriate temperature for hot water dip treatment. For the second set of the experiment the temperature of hot water was kept constant at 70°C, whereas dipping time varied for 1, 3, 5 or 7 min. A simple water wash treatment also conducted alongside as 0-min hot water dip in order

to visualize absolute advantage of hot water dip treatment. The treated samples were drained to remove excess water and allowed to ripen/cure under air circulated drier running at 38-40°C and quality parameters measured after 72 h ripening/curing.

Data collection: Samples of a particular maturity stage were sorted out after testing hardness of the harvested lot. The hardness was evaluated by a hardness-testing device developed by us in the laboratory^[9]. The ripening parameters were estimated soon after harvesting and 72 h after being subjected to curing/drying treatment. The effectiveness of a treatment was evaluated by the measurement of ripening parameters based on changes in color, texture, taste and appearance of the product. Organoleptic ranking tests performed and the fruit ripeness determined.

Estimation of ripeness: The ripeness, defined as a visual change in color of fruit from yellow to brown, was assessed by the measurement of surface area of the ripe portion with the help of transparent paper scale. The ratio of the ripe portion to total fruit surface was calculated (R). A fruit with ≥75% ripe portion was considered as fully ripe and fully cured^[9]. The overall ripening of a sample was computed applying the following empirical formula. The estimated ripening (%) virtually reflects the product yield.

$$\text{Estimated ripening (\%)} = \frac{\sum[\text{Ripeness ratio per fruit (R)} \times \text{number of fruits}] \times 100}{\text{total no. fruits}}$$

Sensory evaluation for texture, taste and overall acceptability: The attributes for these evaluations were based on colour, aroma, texture, taste and appearance. The samples were distributed to ten trained panel members for examination. Graduate students of the Department of Food Science and Technology were trained for this purpose. The judges were asked to score for a particular parameter and rank the scale from 1 to 10 where 1, 2, 3, 4, 6, 8 and 10 stand for very poor/not accepted, poor, fair, good, very good and the best in the quality under evaluation, respectively. Two runs were made for the judgment. Mean score of each sample was counted to determine the effectiveness of a treatment^[11].

RESULTS AND DISCUSSION

Present research endeavor is envisaged to optimize temperature and time of hot water treatment in order to expedite the process of ripening/curing for Dhakki dates. The fruits at fully mature Doka stage within 240 to 260 mm Hg cm⁻² hardness indexes were harvested during the

Effect of water blanch temperature for 5 min



Fig. 1: Ripening of Dhakki dates on treatment with water at different temperatures for five minutes

Table 1: Mean ranking score for sensory attributes of Dhakki dates treated with hot water at different temperatures for 5 min

Temperature of water dip(°C)	Texture	Taste	Overall acceptability*
35	4.1	4.5	5.1
70	5.3	7.2	7.0
93	2.6	4.0	4.1

*Ranking value range from 1-10, 10 being the best

Table 2: Effect of temperature for hot water dip on the degree of ripeness for Dhakki dates

Temperature of water dip (°C)	Fruit ripening (%)
35	42
70	55
93	35

month of August. Several combinations of time and temperature were applied so as to achieve objective conclusively. The performance of a treatment was judged after following the changes in the texture and taste, degree of ripeness as well as overall acceptability of the fruits. The ripening was verified by determining the degree of ripeness that also expresses the estimated yield of the produce. The overall acceptability of the product was assessed so as to ascertain the overall treatment impact.

Influence of temperature of hot water for dipping: The influence of temperature of hot water for the dipping was determined by submerging the sorted fruits into hot water at 35, 70 or 93°C for 5 min. The results are tabulated at appropriate places (Table 1 and 2) and are depicted in Photograph. Ripening treatments influenced the ripening parameters. Amongst various ripening parameters the color of fruit plays a pivotal role. Besides having much importance of color in relation to marketing value, the ripening process is closely related with the color variability and the extent of fruit ripening is reflected by the difference in color shades. Dhakki date changes its color giving different shines from yellow to brown during ripening/curing. Fruit texture and taste also alters on

ripening. The texture of the Doka while fresh is very hard whereas in the ripened state it is soft to flabby depending upon the extent of ripening/curing and the magnitude of aftereffects of the treatment. The ripening parameters tend to change as a result of inside biochemical activities, which are induced in the Doka by the application of hot water. All of the treatments have exerted somewhat effect, however the extent varied with the performance exerted by a treatment. The evaluated performance is based on a score ranked from 1 to 10 where 1 ranked very poor/not accepted and 10 ranked for the best performance and mean values from duplicate evaluation are reported (Table 1).

The organoleptic tests performed to select good quality date in terms colour, texture and taste as well as overall acceptability of the samples indicate that a temperature of 70°C exhibited much better performance compared to treatments at the other temperatures. Maximum scoring of 5.3, 7.2 and 7.0 is recorded, respectively for texture, taste and overall acceptability by this treatment (Table 1). It is also very much obvious from the Fig. 1 that the dipping temperature of 70°C has surpassed the other treatments.

The fruits given the treatment with 70°C were found much soft, pulpy and juicy. The fruits ripened by the treatments with 35°C or 93° C showed lesser degree of softness and ripening (Table 1 and 2). The softened fruits were not astringent in taste and flavor, as if the tannins of the fruit had been precipitated. Further, a uniform ripening from the surface to centre of the fruits was noted. The homogeneous ripening of fruits indicates that the process of ripening started through out the body of the fruit simultaneously. The observations are somewhat contrary to those reported by us previously^[10] and others^[12,13] wherein ripening appeared to initiate from the surface and deepened inside. The mode of action of the brine solution with acetic acid is justified by the fact that the treatment was applied on fruit surface and hence the ripening after

Table 3: Mean score for ripening attributes of Dhakki date treated at 70°C for different periods

Dipping time (min)	Texture	Taste	Overall acceptability*
0	3.9	4.1	4.0
1	6.4	7.8	7.6
3	6.9	8.7	8.2
5	5.3	7.2	7.0
7	3.5	5.5	4.9

* Ranking value range from 1-10, 10 being the best

Table 4: Effect of dipping time for hot water at 70°C on the degree of ripeness for Dhakki dates

Dipping time (Min)	Fruit ripening (%)
0	22
1	67
3	70
5	55
7	40

being triggered from the surface of the fruit had moved into its centre.

Moreover, the amount of the ripening was noticed as maximum of 55% in case of treatment with 70°C, whereas at least 23 and 36% reduction in the ripening yield is found for treatments with 35 and 93°C, respectively (Table 2). Consequently the treatment with 70°C has come up with promising effect displaying about 1.3 and 1.6 times higher yields and fruits of better quality than the treatments with 35° and 93°C, respectively.

Influence of dipping time in hot water at temperature of 70°C:

In order to obtain maximum advantage from the hot water treatment the time for dipping the fruits in hot water at 70°C is optimized. The fruits were immersed in the hot water at a desired temperature for 0, 1, 3, 5 or 7 min prior subjecting the samples to ripen/curing/drying at conditions already established and ripening parameters evaluated (Table 3 and 4). The results indicate (Table 3) that a 3 min dip treatment had performed better giving maximum score of 6.9, 8.7 and 8.2 for the texture, taste and for the overall acceptability, respectively and the product came up superior with 3-min time. The softened fruits were not astringents in taste as if the tannins of the fruit had been precipitated. Treating the fruits either beyond 3-min period or for lesser times had adverse effects on qualities as a result the fruits gradually received lower marking. The texture of fruits for longer dipping times probably suffered discernible damages due to increased fruit wrinkling and hence the acceptability had been reduced which marred the overall ratings. The wrinkling was highly pronounced in case of fruits from the treatment undergone 7-min dip. Wrinkling of the fruits most probably resulted from the collapse of the weakened tissues with disproportionate

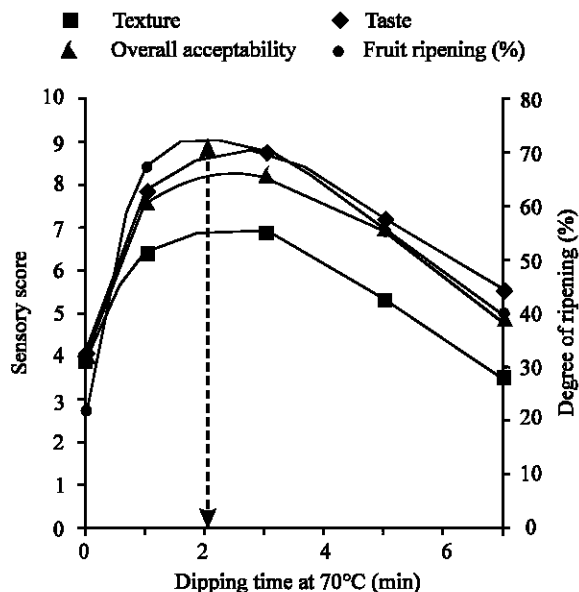


Fig. 2: Influence of dipping time in hot water on ripening qualities of Dhakki dates

moisture losses from the fruits experiencing ripening. The present findings showed similarity with those of Mutlak^[14] and Kalra *et al.*^[12].

Data regarding the degree of fruit ripening for various dipping periods in hot water at 70°C are given in Table 4. Apparently the treatment with each dipping period influenced degree of the ripening of Dhakki date to a certain degree. However, increase in the dipping time beyond 3 min caused a progressive decline in color development for the ripening and hence decreased the degree of ripeness in terms of ripening percentage. Maximum ripening amounting to as high as 70% was noticed from 3 min dip followed by 55 and 40% ripening from 5 and 7 min dipping periods, respectively with ultimate decrease of 30% (Table 4). In order to evaluate maximum efficiency for the hot water process the data of the Table 3 and 4 were plotted in the form of graph (Fig. 2). It is apparent from the figure that the optimum time for dipping in the hot water at 70°C is rather 2 min instead of 3 min as reported in the Table 4. The absolute score as judged by sensory evaluation regarding the entire assessed ripening parameters validates this evidence by showing maximum inflexion at 2 min on the time scale (Fig. 2). It is expected that dipping fruits in hot water for 2 min at 70°C will come up the most appropriate processing period under the prescribed conditions of the experiment and to offer maximum advantage. It is very likely that the ripening system of the fruits receives increased damages by protracted heating henceforth

slowing down the process of ripening in the Dhakki fruits appreciably from 70 to 40% on increasing heat contact for 3 to 7 min, respectively.

Previously it was demonstrated that the ripening is triggered by the application of an optimum dose of microwave radiation^[8,9] and NaCl and acetic acid treatments^[10] while retaining the desired sensory qualities mostly in tact. Invertases in unripe fruits exist as immobile form attached with the protoplasm in the intercellular portion. As ripening initiates, the enzymes on passing into the extracellular site get dissolved readily in water and invert the sugars. Similarly, the hydrolytic enzymes like polygalacturonase and cellulase also cause softening of dates by solubilizing the pectin and cellulose which are the structural bodies holding the cell together^[11]. In the present study, exercising of heat treatment for 2-3 min at 70°C the epidermal cells possibly become ruptured energizing the ripening system, which eventually accelerate the process of ripening. However, excess of heat treatment either using high temperature of 93°C for example, or extended contact with sensible heat impairs the enzymic ripening system inflicting the performance badly. Since considerable ripening did occur in fully matured Doka of 250 hardness after application of the optimized heat doses during the present study, it advocates undoubtedly that lingering of the date fruits on tree for want of Dong (Rutab) formation through natural ripening is absolutely unnecessary. It is thus highly desirable to complete post harvest processing at least 2 weeks before the fall of monsoon and thus got the entire process out from clutches of environmental consequences. The present findings agree with our previous views that there is no wisdom in waiting till completion of on-tree Dong formation. The time, energy and the involved expenses can easily be saved and the damages maximally avoided upon harnessing the ripening assemblage of Dhakki fruits at their proper maturity and catalyzing the enzymic activity by artificial means.

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