Design, development and evaluation of a pitting unit for destoning date-fruits

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ABSTRACT

Iran is the third largest producer and second larger exporter of date fruits. Pitting is one of the processes that increase the fruit economic value. In the present study a clamp-type pitting unit for date fruit was designed, developed and evaluated as a new approach. In principle each unit of the automated mechanism uses a clamp with two forks made of stainless steel, the unit is elastic in nature. Pitting unit was evaluated on mazafati cultivar at three nominal rates of pitting (30, 60 and 90/min.) and at five moisture content levels (20, 22, 24, 26 and 28 % w.b.). Analyses of the data showed that moisture content does not affect percent stone removal whereas rates of pitting had significant effects on percent stone removal. Average percent stone removal for various mc levels was 50%, similarly average percent stone removal for various pitting rates was 50%. However maximum percent stone removal of 80 % could be obtained at two combinations of pitting rate and mc level (30/min. & 26% and 60/min. & 24%). The average percent flesh loss was 2%, which is considerably low and therefore acceptable. Average change in fruit length was limited to 11% which does not seem to affect the market value of the destoned fruits. As the rate of pitting increased, the percent change in fruit diameter tends to increase too. When fruit mc increased reverse trend was noticed. Although not significant, an overall change in fruit diameter equal to 9% was noticed. this study showed that the highest pitting (80%) can be achieved when dates are pitted at pitting rate of 60/min. and mc of 26%. for this adjustment lost flesh, change in fruit height and diameter change were 2%, 11% and 9%, respectively.

Keywords: Date palm, Date fruit, Destoning, Date fruit post-harvest.

INTRODUCTION

According to the FAO statistics, the world production of dates during 1996 touched a new record of 4492000 tons (Anonymous, 2013). Iran has emerged as the world's largest producer followed by Egypt. In spite of this production level, advance research and technology for processing and packaging machinery is unfortunately not well progressed (Mikki, 1998). Automatic sorting by camera computer system has not been successful so far on commercial scales. Picking rejected dates due to various defects in the inspection line is not still visualized. Although destining machinery has been developed for some fruits, little attention has been devoted to develop destining techniques for date fruits. Destoning machines presently available are designed and fabricated mainly for cherries, apricots plums or olive, but are supplied to date packers with little modifications.

Available machines are designed and developed for limited number of varieties and therefore more research is needed to develop new machines capable of destoning in various conditions. The uniformity of fruit shape and volume which varies from one cultivar to another and proper positioning individual dates in cups are the most important problems facing development of destoning units (Chesson *et al.,* 1997).

Nourozi and Raoufat (2005) developed and evaluated a destoning unit for individual dates. The two main parts

were a singulator unit and a pitter unit. The automatic date pitter unit comprised of two parts, a cup for holding individual date fruit and a special probe to push the stone downward leaving the flesh intact. A magnetic switch operated by a timer-circuit pushes the probe into the cup in line with the centerline of the fruit placed in the cup. They evaluated the unit at various levels of fruit moisture content and impulse of the pitting probe. Results of their study showed that as the fruit mc increases, the percent flesh loss and fruit deformation increases in a significant manner. They recommend that for minimum percent weight of flesh loss and deformation, date fruit moisture content should be maintained around 25%. Oskooei-Shomali (2006) improved the performance of above destoning unit.

However, the above machine suffers from appropriate plunger movement in the fruit and poor vertical alignment of the plunger and fruit cup. Considering the drawbacks associated with the destoning units, the present study was devoted to design and development of a new destoning unit capable of moving the stone out of the fruit leaving flesh intact.

MATERIALS AND METHODS

Design and development

To realize the above objectives, a clamp-type pitting unit for date fruit was designed and manufactured (Fig 1.) In principle, each unit of the automated mechanism uses a clamp and two forks made of stainless still, the unit is elastic in nature. The assembly comprised of four main parts: chassis, power transmission, electrical circuit and finally destoning unit. The destoning unit uses a unique mechanism to pull the stone out of the fruit. A stainless steel clamp with fully flexible jaws moves forward, holds the stone and finally retracts to complete a cycle. The jaws of the clamp type unit open and close as the clamp moves forward and retracts. A platform equipped with specially designed longitudinal slots is used to actuate clamp in each pitting cycle. As the clamp retracts a cam accommodated in the guide forces the jaws open and leave the stone alone.

The power transmission assembly uses two sets of belt & pulley to decrease the electric motor speed to one-sixtieth that of the motor. A 90 W electric motor with a maximum rpm of 4000 was used to drive the unit. The speed of the unit could be adjusted to the desired level by an electrical circuit incorporating a dimmer to control output speed.

Performance evaluation

The fresh Mazafati date was prepared from local market and kept in a refrigerator at 4^{O} C. In the next stage the fruits were conditioned to adjust their moisture content to five levels of 20,22,24,26 and 28% (wb.).

Pitting unit was evaluated on Mazafati cultivar at three rates of pitting (30, 60 and 90, Nominal number of pittings/min.) and at five moisture content levels (20, 22, 24, 26 and 28 % w.b.). Each of the above rates could be established using the electrical circuit controlling motor output speed. Therefore a total of 15 treatments were considered in each replicate.

Four separate tests were conducted on samples of size 10 dates fruits (10 replicates). The tests were conducted to evaluate percent change in destoned fruit diameter, percent change in destoned fruit length, percent destoned fruits and finally percent flesh weight loss. The data were collected and analyzed and compared.

RESULTS AND DISCUSSION

Analyses of the data showed that moisture content does not affect percent stone removal whereas rates of pitting had significant effects on percent this important index. Average percent stone removal for various MC levels was 50%, similarly average percent stone removal for various pitting rates was 50% (Fig. 2). However maximum percent stone removal of 80 % could be obtained at two combinations of pitting rate and MC level (30/min. & 26% and 60/min. & 24%). Other results indicated that none of the two parameters and their interaction have significant effect on percent flesh loss during pitting operation. The average percentage of flesh loss was 2% that is considerably low and therefore acceptable (Fig. 3).

Date fruit MC levels, pitting rates and their interaction did not show to have any significant effect on percent change in date fruit length due to pitting operation. However, average change in fruit length was limited to 11% which does not seem to affect the market value of the destoned fruits (Fig. 4). As the rate of pitting increased, the percent change in fruit diameter tends to increase too. When fruit MC increased reverse trend was noticed. Although not significant, an overall change in fruit diameter equal to 9% was noticed (Fig. 5). This study showed that the maximum pitting (80%) can be achieved when dates are pitted at pitting rate of 60/min. and MC of 26%. For this adjustment lost flesh, change in fruit length and diameter change were 2%, 11% and 9%, respectively.

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Figures

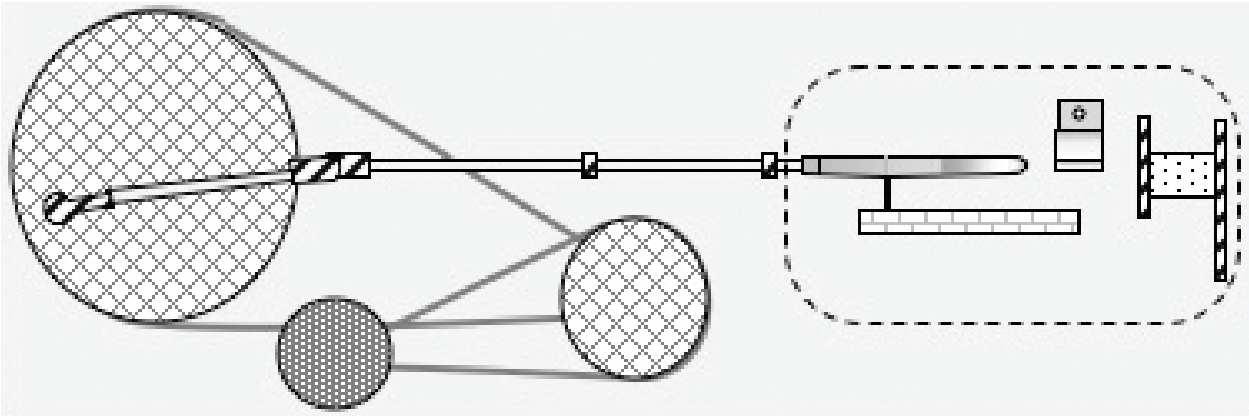

Fig. 1. Layout of the destoning unit developed in this study

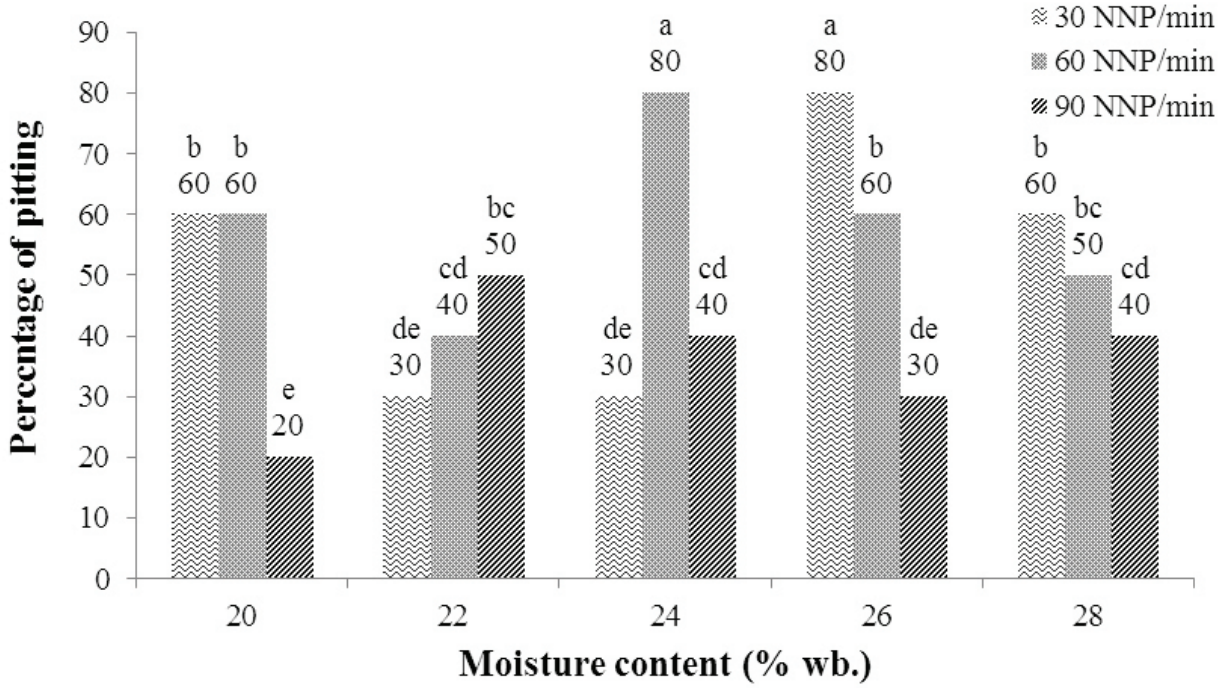

Fig. 2. Percent destoned fruit for various treatments

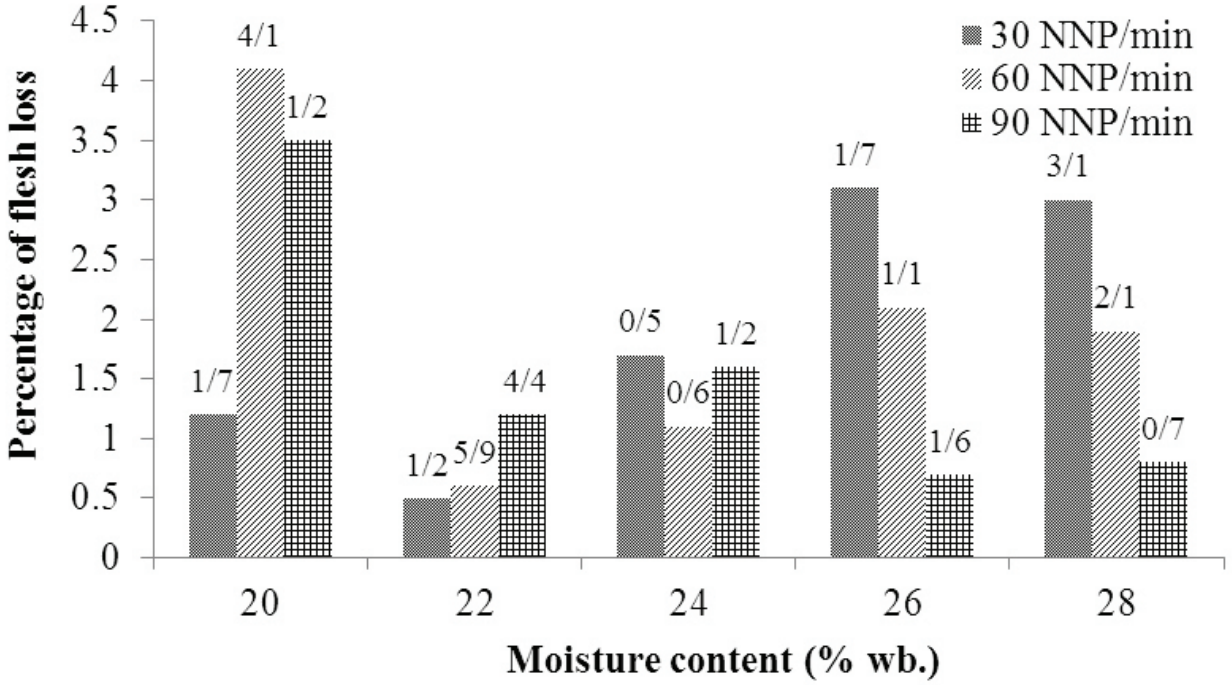

Fig. 3 . Percent flesh weight loss for various pitting rates and moisture contents

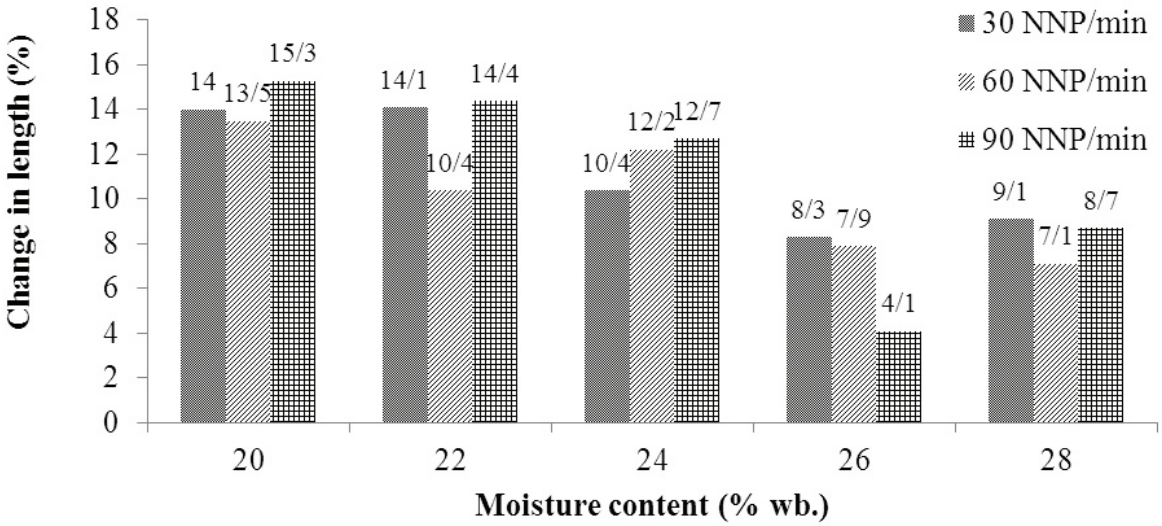

Fig. 4. Percent change in Fruit length for treatments studied

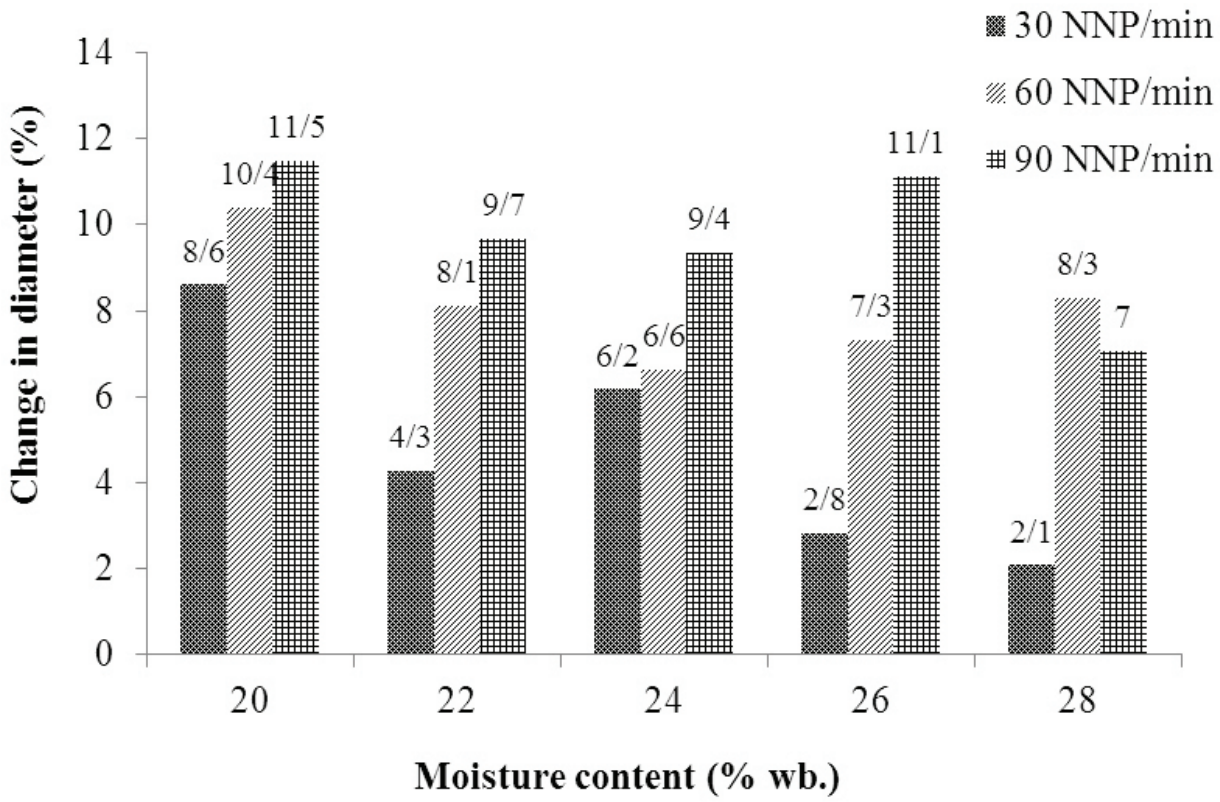

Fig. 5. Percent change in fruit diameter for treatments studied