International Research Journal of Education and Technology

Peer Reviewed Journal

ISSN 2581-7795

DESIGN AND FABRICATION OF POMEGRANATE ARIL REMOVER

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ABSTRACT

Manual processing of pomegranates consists of cutting the fruit by knife into pieces and then separation of arils by hand tends to be highly labour intensive, time consuming and unhygienic. The present investigation was undertaken to develop pomegranate aril remover. The physical and engineering properties of pomegranate fruit and aril were determined for design of various parts of aril remover. The hand operated pomegranate aril remover were designed, tested and were found suitable for aril removal. The hand operated pomegranate aril remover consisted of a operating handle, spring loaded reciprocating arms, semi circular solid hitting discs or heads, movable fruit holding platform, aril collecting chutes, aril collecting tray and frame. The arrangement was made for the semi circular solid hitting head to move in reciprocating motion to hit the inverted halved fruit and remove the arils. The hand operated pomegranate aril remover was evaluated at hitting height (0 to 2 cm). The hand operated pomegranate aril remover were compared with manual aril removal method.

Keywords: Pomegranate processing, Aril removal, Manual labour, Engineering design, Reciprocating motion.

1. Introduction

Pomegranate is considered a healthy fruit and is widely used in many areas of the food industry. The versatile adaptability, table and therapeutic values and better keeping quality are the features responsible for its cultivation on a wide scale (Dhandar and Singh, 2002).

The edible part of the fruit is the fleshy arils inside the outer shell, the percentage of which ranges from 50 per cent to 70 per cent (rest carpellary membranes and rind) of the fruit. Pomegranates are not only used for eating but they are also used as medicines. Sugar content of pomegranate juice are about 12 to 16 percent. Pomegranate contains several hundreds of arils completely held within the fruit. Manual processing of pomegranates consisting of cutting the fruit into pieces by knife and then separation of arils by hand tends to be very inefficient and highly labour intensive, time consuming and irritating. Arils are so firmly attached to each other and with rind and peel that it makes difficult to separate manually for processing in large quantities. Industrial processing of pomegranate provides an

opportunity to create a new and innovative market for fresh arils, dried arils, juices, wines, health and pharmaceutical products.

Pomegranate fruits come to harvest in different months of the year viz., April – June and December – January. Subbanna and Sathyanarayana (1989) [1] stated that well grown tree produced about 100 - 150 fruits weighing 20 – 30 kg, with an average fruit weight of 220 g each. Pomegranate (Punica granatum L.) belongs to the family Punicaceae which includes only one genus and two species, the other one Punica protopunica. The native types of the pomegranates can be found in the Middle East countries, Iran, Afghanistan, Pakistan and India. It is mainly growing in subtropical areas of Mediterranean countries, South Africa, Pakistan, India and USA, and California (Blumenfeld et al., 2000).

Milson and Kirk [5] (1980) reported that true density of fresh fruits ranges between 865 to 1067 kg/m3 and that of fresh vegetables as 801 to 1095 kg/m3. Mohsenin (1980) reported bulk density of different fruits and vegetables such as, tomatoes: 672 kg/m3, peaches: 608 kg/m3, lemon/oranges: 768 kg/m3, grapes: 368 kg/m3, carrots: 640 kg/m3.

Morrow et al.[6] (1984) analyzed data from weight, volume, specific gravity and dimensions of apples to establish relations between size and weight parameters. Results from regression equations are useful to processors and packers in comparing the effectiveness of size and weight sorting equipments.

2. Experimental Procedure

2.1 Manual Removal Of Pomegranate Arils

For each test, the weight of the fruit was determined using a digital balance. Then penetration readings were taken using penetrometer for all pomegranates to check and compare the strength of peel. The arils were separated manually using a stainless steel knife, cutting the fruits into half with the help of knife and collecting the arils . The time taken for separation of arils was noted down using a stopwatch in order to determine the capacity, efficiency, aril loss and cost of separation of arils manually. The average time taken by each labourer was calculated.

The procedure was repeated five times. The data was compared with the hand and power operated aril removers.

2.2 Design And Development Of Pomegranate Aril Remover

The first step in processing of pomegranate is to extract or separate the arils (juice-enclosed seeds) from its peel and other non-edible parts of the fruit. It has been felt that fresh arils may have a promising market if packed in attractive package for direct consumption or further processing into various products.

The traditional method of extraction of aril from pomegranate involves cutting the fruit into two halves and then removing the arils by hitting on the fruit by a wooden mallet. This method also cuts some arils and shortens their shelf life. For juice the separated arils are

INTERNATIONAL CONFERENCE ON CORE ENGINEERING AND TECHNOLOGY '2024 (ICCET'24), PERI INSTITUTE OF TECHNOLOGY, CHENNAI-48; ISBN: 978-93-340-4983-1

pressed in the screw press or basket press. Juice extracted is clarified by chemical methods because peel contributes high amount of tannins and other undesirable biochemicals.Since a pomegranate contains several hundreds of arils, manual processing of pomegranates consisting of cutting the fruit by knife into pieces and then separation of arils by hand tends to be very inefficient, highly labour intensive, time consuming and unhygienic. To separate the intact arils from the fruit, there is no need to cut the fruit cross-sectionally; but only needs cutting of outer peel so that the pomegranate can be easily broken into pieces by using the fingers. Arils are so firmly attached to each other and; with rind and peel that it makes difficult to separate by fingers. Hence, a pomegranate aril remover was designed and developed.

2.2.1 Construction details of Hand operated pomegranate aril remover

The hand operated pomegranate aril remover consisted of a operating handle, spring loaded reciprocating arms, semi circular solid hitting discs or heads, movable fruit holding platform, aril collecting chutes, aril collecting tray and frame.

(a) Operating handle

The operating handle is made of a mild steel which is of 65 cm in length.

(b) Spring loaded reciprocating arms

Two arms made up of mild steel shafts of length 20 cm which are connected by four stainless steel springs to bring about the reciprocating action.

(c) Semi circular solid hitting discs or heads

It is made of a two 10 cm diameter with a food grade stainless steel of 2 mm thickness fitted with spring loaded reciprocating arms.

(d) Fruit holding platform

The movable fruit holding platform is made of food grade stainless steel rods of 10 mm in diameter. It is a perforated platform with a dimension of 40 x 28 cm with a spacing of 4 cm in between the pipe.

(e) Aril collecting chutes

The chutes are plastic of 2 mm thick fixed under the fruit holding platform of 25cm of width and 40 cm of length

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Fig 90.1 Hand operated pomegranate aril remover

3. Discussion

The physical properties of pomegranate were studied, as these properties are necessary for design and development of pomegranate aril remover. The minor diameter of the fruits varied between 54.75 to 70.43 mm. The major diameter of the fruit varied between 62.85 to 76.21 mm. The shape of the pomegranate fruit resembled the round to oblate shape. The shape of aril resembled elliptical shape. The mean weight of the pomegranate fruit varied from 112 to 202 grams. The mean bulk density of pomegranate fruits was found to be 497.14 kg/m3. The mean true density of pomegranate fruit was found to be 919.60 kg/m3. The percent moisture content of pomegranate fruit was 36.31. The firmness of pomegranate fruit was found to be 13.16 kg/cm2. The values of L*, a* and b* values of fresh fruits were 50.06, 39.45 and 30.73. The aril to peel ratio varied in the range of 1.73 to 1.34. The force required to penetrate the fruit, i.e, average peak force value for fresh pomegranate fruit was 3046.93 g with 3.65 mm distance. The data indicated that there was a variation in physical properties of pomegranate fruit. The average values of diameter, length, weight, peel thickness, aril peel ratio, true density, bulk density firmness, shape and colour of pomegranate fruit.

3.1 Aril loss

The effect of hitting heights on aril loss during aril removal with the hand operated pomegranate aril remover . It could be observed that the aril loss generally decreased with increase in the hitting height. At 2 cm hitting height when the semi circular head came down there was a preliminary tapping (impact) force on the top of the fruit that actually loosen the arils (from the peel) which subsequently falls down the chute during compression force applied by the head leaving the peel on the platform. When the hitting height is 0 cm the head actually compressed the fruit without tapping effect resulting in higher loss due to crushing of arils.

Conclusions

1. Power operated pomegranate aril remover performed better than hand operated pomegranate aril remover and manual removal of arils
2. At the hitting height (2 cm) the aril removed by the hand operated pomegranate aril remover was found to be satisfactory in achieving output (14 kg/h), higher efficiency (75.46%) with lower aril loss (1.57%).
3. The cost of aril removal by hand operated pomegranate aril remover Re. 0.74/kg which was cheaper than traditional method.
4. The cost of aril removal by hand operated pomegranate aril remover was Re. 0.74/kg.

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