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DESIGN AND DEVELOPMENT OF POMEGRANATE DESEEDING MACHINE

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ABSTRACT

Pomegranate has various medicinal properties. The first step in processing the pomegranate is to separate edible part from the outer hard shell. Traditionally a pomegranate is deseeded by hand. It is cut into pieces and arils are separated from the shell. It is labour intensive and consumes lot of time. Alternatively to deseed the pomegranate, it is cut in half and is hit with a spoon on the hard outer shell. This method is mechanized for faster processing. The main objective of this project is to automate the process of deseeding. Two large spoons are used as cantilever beam. These spoons provide the tapping force required to deseed the pomegranate. Spoons are coupled to a shaft which provides the spoons with force and movement. This movement of spoons is carried out for specified time, with time delay, gives hammering act over the fruit. The seeds are collected in a tray below the machine. The machine is turned off after all the arils are removed.

Keywords: Pomegranate,Spoons, Bell and drum mechanism,Innovative design and manufacturing

I. INTRODUCTION

The pomegranate (*Punicagranatum*) originated in the region of modern-day Iran, and has been cultivated since ancient times throughout the Mediterranean region and northern India. Nearly all parts of this fruit can be utilized but the crop is important mainly for its arils (the edible portion of the fruit). The fresh arils can be used as a garnishin fruit cups, compotes, salads and desserts, and as a snack. The fruit peel is well regarded for its astringent properties.After the pomegranate is opened by scoring it with a knife and breaking it open, the seeds are separated from the peel and internal white pulp membranes.Pomegranate juice has long been a popular drink in Europe, the Middle East and is now widely distributed in the United States and Canada. Pomegranate seeds are used as a spice known as *anardana*, most notably in Indian and Pakistani cuisine. Traditionally pomegranate is peeled by hand and it takes lot of time. The main aim of the deseeding machine is to reduce human effort and time with its simple design and ease of use. The machine will consist of parts readily available and easy to maintain [1].

II. LITERATURE REVIEW

The extensive literature review carried out for development of Method and a System for Extracting the Seeds (Arils) from Pomegranate Fruits - from Concept to Commercial Utilization

Z. Schmilovitch et al., (2009), presented the work on the method for extracting the arils from the pomegranate fruit is based on utilizing an oscillating air jet scanning the surfaces of an opened fruit to extract the arils. The efficiency of extracting mechanism depends on factors such as size, shape and placement of arils inside the fruit. The fruit handling system consist of conveying the fruit to the plant; moving the fruit through various stations to perform the operations of opening the fruit; exposing the opened fruit to the extracting mechanism & separating the arils from extraneous material and delivering the clean and sorted arils to the packaging machine. This machine is intended for commercial use only and has been implemented by an Israeli manufacturer -'Juran Metal Works Ltd.'Proc. I st IS on Pomegranate Ed.: A.I. Özgüven Acta Hort. 818, ISHS [2].

A.K. Thakur et al. (2009), presented work on the hand tool for easy separation of arils from pomegranate consists of fruit holders having a knife arrangement in such a way that it only penetrates into the peel. Pomegranate fruit has to be held between the pair of holders, and the holders are turned by hand in opposite direction of each other.Due to the rotating action the fruit breaks into two halves. During this action the whole fruit experiences a shearing effect; and due to this effect the inside arils become loosened, thus they can be easily separated. This tool is hand operated and cannot be used for large production of arilsProc. IInd IS on Pomegranate and Minor, including Mediterranean Fruits (ISPMMF - 2009) Eds.: M.K. Sheikh et al. Acta Hort. 890, ISHS [3].

K. Gomathi et al., (2015), presented the work on the machine consists of the cantilever beam, electromagnet, proximity sensor & microcontroller 89C51 and a tray to collect the arils. Cantilever beam is used to provide the tapping force over the fruit and it gets attracted by energizing of the electromagnet and by de-energizing the electromagnet, the beam gets repelled. The fruit is kept in inverted position and the cantilever beam hits the hard outer shell, thus removing the arils from the fruit. This process of energizing and de-energizing is repeated for a certain time and with a time delay and this process continues as per the program.International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297:2007 Certified Organization) Vol. 4, Issue 5.[4]

P.B. Patole and V. V. Kulkarni, (2017), presented work on analysis of MQL process parameters and design of experiments. Also they have done the work on MQL design system and design procedure. Manufacturing Technology Today, Vol. 16, No. 7[5].

From mentioned literature review it is found that no machine is developed in surrounding area so decided to design such kind of machine having compact in size with low cost as well as easy to use everyone.

III. METHODOLOGY AND DESIGN

First search and survey on SPM machine that works on pomegranate. During searching and surveying came to know that there is no availability of such kind of machine which deseeds the pomegranate with compact size. Finally, design, manufacture and assemble this machine. For that machine use bell and drum mechanism which is widely use in temple. So, simple mechanism, compact in size, hygienic during operation.During experimental

work learned that how to manufacture, design, assemble SPM machine as well as gives information about surrounding market.

*Design steps:

1) Shaft Design:

* Assumptions:Motor RPM = 200, Length of gear mounted on shaft = 60mm, Diameter of gear = 65mm, No. of teeth on gear = 45,Ultimate tensile strength, SUT = 440 N/mm^2, Bending Stress, σ_b= 155 N/mm^2

* Selection of material: low carbon steel

*By calculations:

T = 17809.43 N-mm

$T_{max=}$ 138.67 N/mm^2

F_t = 547.9825 N

load W = F_t/cos α = 583.150 N

Max bending moment: M = 8747.25 N – mm

By calculations Diameter of shaft = 9 mm

2) Bearing design

* Assumptions

The bearing type is 6204 ZZ

According to the type of bearing, select the values of parameters from manufacturing catalogue.

Internal diameter of bearing (d)=20 mm, External diameter of bearing(D)=47 mm, Axial width of bearing(B)=14 mm, Load factor=2, Mass of bearing =0.11 kg.

Assuming, forces acting on bearing as,

Axial force(Fa)=800 N

Radial force(Fr)=2400 N

Revolutions per min (n)=200 rpm

* Calculate equivalent dynamic load C=P*(L10)1/3= 12914.01

Hence, Selected bearing of given series 60 has required dynamic capacity.

Design is safe.

3) Gear design

* Assumption:

P = 373 watt

N = 200 r.p.m.

No. of teeth = 95

* Selection of material: Cast Iron

* By calculations:

Module (m) : 2 mm

Addendum (m) : 2 mm

Dedendum (1.25 m) : 2.5 mm

Clearance (0.25 m) : 0.5 mm

Tooth Thickness (1.5708 m) : 3.14 mm

Fillet radius (0.4 m) : 0.8 mm

Gear has module 2 mm with 95 teeth as well as O.D. of 150 mm.

Design is safe.

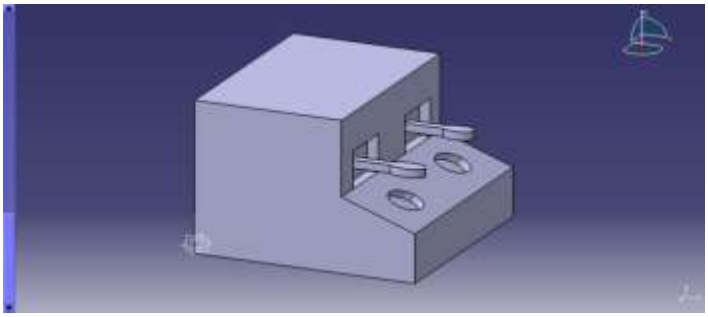

Fig 1: Pomegranate Deseeding Machine

- The above figure shows the pomegranate deseeding machine
- 1 inch M.S. square pipe is used to construct the base frame
- Frame is welded together

- This facilitates uniform removal of arils
- 3 gears are used, of which two gears are of 150 mm OD with 95 teeth and the remaining gear is of 65 mm OD with 45 teeth
- The circular disc is 12 mm thick and has 150 mm diameter
- The dimensions are: 600x600x600 mm
- Objectives of this machines are, To design and develop special purpose machine, To reduce working time, To maintain hygiene, To save labour cost

IV. CONCLUSION

This model of pomegranate deseeding machine is designed to reduce human efforts and increasing the production. It also limits the human contact with the fruit thus maintaining the hygiene. It satisfies the needs of small scale business which are not able to buy expensive machine. The model is built with very basic material and has minimal operating cost & eco-friendly and it can be used with less effort.

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