

Design and Fabrication of Punch Cum Splitter For Tender Coconut

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ABSTRACT

There is a heavy demand for tender coconut in today's market as it contains nutrients, it helps in dissolving kidney stones, reduces blood pressure, energy drink etc., and it's a natural gift. But making a punching and slicing a tender coconut have some difficulties it cause injuries, aged people, handicapped people feel difficulties to do this. Our project aims to develop automatic punching and slicing a tender coconut. The machine consists of 7 main parts: 1. Air compressor, 2. pneumatic cylinders, 3. Direction control valve, 4. Hose pipe, 5. Punching bit, 6. Cutting blade and 7. Supporting frame. The punch cum splitter for tender coconut is operated by Pneumatic system. The tender coconut is placed on the holder ring, once actuated the air compressor supplies the compressed air to the pneumatic cylinder the Pneumatic cylinder containing a punching bit makes a hole in a downward direction and move back. After consuming it's water it is placed on other side of the frame for slicing operation. Similarly the slicing operation will be done. The force required to make a punching a tender coconut and for slicing a tender coconut it measures to 251 N and 807 N. The time required for making punching and slicing a tender coconut measures to be 10 second and 15 second. The time required to make a punching and slicing a tender coconut will be less, safer to operate and the maintenance cost is less as the operating fluid is air.

Keywords-Tender coconut, punching, slicing, force, time, difficulties, pneumatic system.

INTRODUCTION:

The coconut tree (*Cocos nucifera*) is a member of the [family *Arecaceae*](#) (palm family). It is the only accepted species in the [genus *Cocos*](#). The term coconut can refer to the entire coconut palm, the [seed](#), or the [fruit](#), which, botanically, is a [drupe](#), not a [nut](#). Coconut palms are grown in more than 90 countries of the world, with a total production of 62 million tonnes per year

Coconut is the "tree of heaven", provides many necessities of life including food and shelter. It is mainly cultivated for its nuts; it yields oil, oil cake and fibre. Water from tender coconut is a common refreshing drink and has been used as an excellent isotonic in several tropical countries. It is not only a thirst-quenching liquid, but also a mineral drink, which is beneficial to human health. It contains traces of proteins, fats, and minerals like Na, K, Ca, Fe, Cu, P, S, Cl, vitamin C, vitamins of the B group like nicotinic acid, pantothenic acid, riboflavin and biotin. Coconut water contains organic compounds possessing healthy growth promoting properties. It carries nutrients and oxygen to cells, raise the human metabolism, boost human immune system, detoxify and fight viruses, control diabetes and also aids the human body in fighting against viruses that causes flue, herpes and AIDS.



Fig 1: Tender coconuts

The other benefits of Tender coconut are,

There is some evidence that coconut water may help build up immunity, improve kidney function, prevent urinary tract infections (UTI) and lower high blood pressure. Some mums find that drinking coconut water helps relieve morning sickness, constipation and acidity that are common problems during pregnancy.

In traditional medicine or Ayurveda, tender coconut water is used as a laxative, it is cooling believed to ward off vomiting and bilious fever. The tender coconut water, the wholesome natural beverage is mostly sold on road sides and there is no means to sell the same inside the offices and buildings as the process of cutting the tender coconut is a tedious, hazardous and risky job and it needs special skill. Tender coconut water is an unadulterated, natural, medicinal, drink for all peoples.

Tender coconut plays an important role in the economic, social and cultural activities of millions of people in our country. India is the major producer of tender coconut in the world. Coconut provides nutritional water to drink and kernel to eat.[1]

The existing methods used to punch and slice the tender coconut are,

a. Conventional method of tender coconut opening



Fig2: Conventional method of tender coconut opening

From past years the tender coconut is being opened and cut by completely manual effort by using a hard knife. The tools used are unsafe, messy and need skill and training. The risk of injury is also too high other drawbacks are as mentioned below.

Limitations:

- Risk of injury
- Handicapped people not able to do business
- Not able to provide tender coconut as soon as customer orders for new workers
- Aged people not able to do this.

b. Manual operated punch cum splitting the tender coconut



Fig 3 : Manual operated punch cum splitting the tender coconut machine

The force required for slicing a tender coconut is more and during punching a tender coconut the dust particle (impurities) present on the top of tender coconut will enter into tender coconut water which is not feasible to drink. Other drawbacks are as mentioned below.

Limitations:

1. Manual effort is needed.
2. Requires maximum force to slice the tender coconut.
3. Aged people not able to do this.
4. Women's also not able to do this.

The existing methods are risky, unsafe, time consuming and not suitable for some class of people to operate the machine. Therefore the present study aims to develop a punch cum splitter for tender coconut by Pneumatic system it is easy to operate, time saving, no risk of injury.

1. MATERIAL AND METHODS

1.1 Design details

The punch cum splitter for tender is operated by Pneumatic system. The main components of this machine are Air compressor, pneumatic cylinders, Direction control valve, Hose pipe, Punching bit, Cutting blade and Supporting frame.

A. Selection Of Pneumatic Cylinder

By reference paper [2] Titled Development of a Household Coconut Punch-cum-Splitter.[T.Roshni, J.Jippu, C.S. Rateesh, J.Sachin and K.L. Sreevisakh]

Energy required for punching a tender coconut is 11.73 N-m and force required is 712N

Then, Diameter of the punching,

$$D = \sqrt{w} / \sqrt{\pi}$$

$$D = \sqrt{11.74} / \sqrt{\pi}$$

$$D = 1.93\text{m}$$

Considering factor of safety as $N=1.5$

$$\text{Then, } d = 1.93 * 1.5 = 2.89\text{m}$$

$$\text{ie, } D = 29 \text{ mm}$$

W.K.T

$$\text{Pressure, } P = F/A$$

$$A = \pi d^2 / 4$$

$$A = \pi * 0.029^2 / 4$$

$$A = 0.00066 \text{ m}^2$$

$$\text{Then, } P = 712 / 0.00066$$

$$P = 10 * 10^5 \text{ N/m}^2$$

$$P = 10 \text{ bar}$$

Motion pattern	Double acting cylinder
Full bore piston diameter	63mm
Piston rod diameter	20mm
Working pressure range	1 to 10 bar
Operating Temperature range	-5 to 70 ⁰ C
Operating Speed	50 to 800 mm/s

B. Punching bit

Designed based on the average Tender coconut dimensions

By measuring the length from top of Tender coconut to the water level it's measures to be average of 5cm. So by giving 2cm extra length to the Punching bit a total length of 7cm(70mm) is made.

In the punching bit 20mm provision is provided to remove the dust particle during punching of a Tender coconut. The punching material selected is Stainless Steel as it has corrosive resistant properties and has good strength.

C. Slicing Blade

Designed based on the average Tender coconut dimensions

By measuring the total length of Tender coconut it's measures to be average of 20cm. So by giving 10cm extra length to the Cutting blade a total length of 30cm(300mm) is made.

The Cutting blade material selected is Stainless Steel as it has corrosive resistant properties and has good strength.

D. Hose pipe

This direction control valve has been selected because it can withstand up to the pressure of 10 bar and it can be used for controlling the cylinder of bore diameter 0.063m.

Model	DS2
Type	5/2
Design	Spool type
Medium	Compressed air
MaX. Working Pressure	10 bar
Ambient / Medium temperature	5° - 60° C
Flow @	1200 lts/min
Materials of construction	Aluminium, Nitrile, Brass, Aceta

2.WORKING MODEL

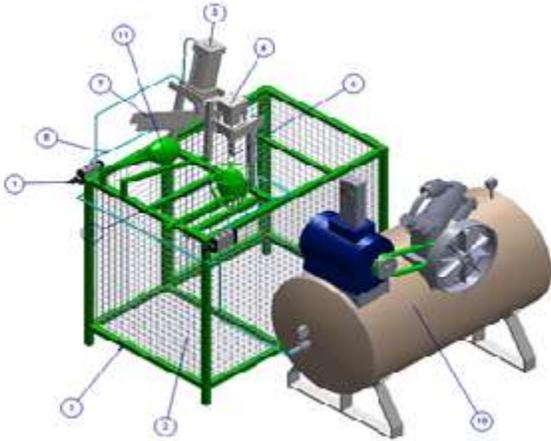


Fig 4 : 3D view of punch cum splitter for tender coconut

(1-Base frame,2-Mesh,3-Holder ring,4-Pneumatic cylinder for punch,5- Pneumatic cylinder for slice,6-Punching bit,7-Slicing blade,8-Hose pipe,9-Solenoid valve,10-Air compressor,11-Tender coconut.)



Fig 5 : Working model of punch cum splitter for tender coconut

Working principle

The tender coconut is placed on the holder ring, once actuated the air compressor supplies the compressed air to the pneumatic cylinder then by operating a solenoid valve by pull button the Pneumatic cylinder containing a punching bit makes a hole in a downward direction and move back by operating push button of valve. After consuming it's water it is placed on other side of the frame for slicing operation.

The cutting blade is mounted to the another pneumatic cylinder by pressing a pull button of the solenoid valve the cutting blade slices the tender coconut into two halves which is ready to eat the kernel and by pressing the push button of the solenoid valve the cutting blade return to its original position.

3.CALCULATIONS

The Force required to Punch the tender coconut is ,

We know that

$$\text{Pressure, } P = F/A$$

$$\text{Then, } F = P \times A$$

Where, P = The pressure from the Compressor (N/m²)

A = Area of Punching (m²)

F = Force required to Punch (N)

$$F = 8 \times 10^5 \times A$$
$$A = \pi \times (0.02)^2 / 4$$
$$A = 3.14 \times 10^{-4} \text{ m}^2$$

$$F = 8 \times 10^5 \times 3.14 \times 10^{-4}$$

$$F = 251 \text{ N}$$

The force required to slice the tender coconut is,

Pressure, $P = F/A$

Then, $F = P \times A$

Where, A = Area of Slicing (m²)

A = LXS where L = Average Length of slicing and S = Thickness of slicing

$$A = 0.17 \times 0.05$$

$$A = 8.5 \times 10^{-4} \text{ m}^2$$

Hence, $F = 9.5 \times 10^5 \times 8.5 \times 10^{-4}$

$$F = 807 \text{ N}$$

4.CONCLUSION:

Pneumatically operated punch cum splitter for tender coconut machine is developed with low cost. The force required to punch the Tender coconut is 251 N and for slicing 807 N. By experimentation the time required for punching and slicing a Tender coconut is 10 seconds and 15 seconds respectively. So it is very useful to the sellers of Tender coconuts to install this machine as the maintenance cost is also very less.

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