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DESIGN AND FABRICATION OF ARROW ROOT EXTRACTOR

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Abstract: **Electronic Arrowroot refers to any plant of the genus Maranta, but the term is most commonly used to describe the easily digestible starch obtained from the rhizomes of Marantaarundinacea. Arrowroot juice extractor is a machine which crush the roots into small pieces using cutter and then squeeze it using feed screw to extract the juice and the remaining pulp or the waste is carried to other end and removed. It is used to obtain continuous crushing of the roots and continuous removal of juice and the pulp.**

Keywords: *Arrow root, Feed screw*

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I INTRODUCTION

Arrowroot is a starch obtained from the rhizomes (rootstock) of several tropical plants traditionally Maranta arundinace a, but also Florida arrowroot from Zamia pumila, and tapioca from cassava (Manihot esculenta), which is often labeled as arrowroot. Japanese arrowroot, Pueraria lobata, also called kudzu, is used in similar ways. In this work effort is made to develop a juicer equipment to reduce manual work and time of operations. It consists of a hopper where arrow roots are fed. This is cut into small pieces using a cutter which consists of blades. These pieces falls onto the feed screw which runs on a motor provided with gears which squeezes the arrow root using its tapered sectional part. The juice is thus extracted from it and the pulp is carried to the other end of the machine by the shaft itself. Thus juice and pulp is extracted separately. The fruit juice extractor consists of three parts. Cutting blades to reduce the fruit into small pieces. These can be either a spiral scraper or small blades. The part of the extractor used for squeezing the fruit and separating the residues consists of a sieve, a blade, a screw, and a compartment to hold the residues.

II DESIGN

Arrow Root juice Extractor consists of 13 parts which includes

1. Main base
2. Motor coupling
3. Chain drive
4. Hopper
5. Gears
6. Sprocket,
7. Cutter shaft
8. Main cylinder
9. Stirrer
10. Housing
11. Bearing
12. Tray

1. Main Frame:

Specifications:

Height of Frame 1=300mm
Height of Frame 2=400mm
Length of Frame=700mm

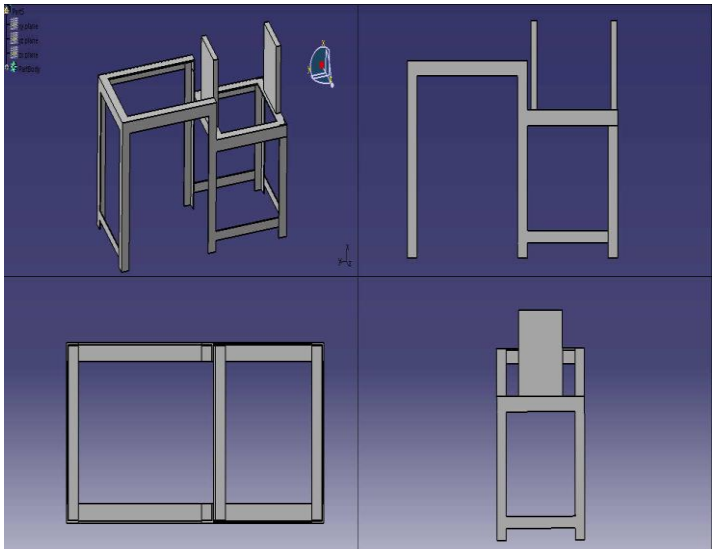

Figure 1:3d View of Main Frame

2. Main Cylinder with Hopper:

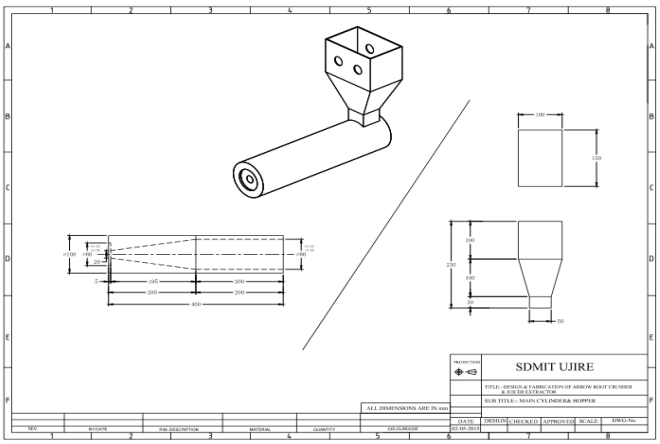

Figure 2: 2d view of Main Cylinder with Hopper

Hopper Specifications:

Area of hopper = 15000mm^2

Volume of Hopper=1500cm^3

Height of hopper=100mm

Capacity of hopper=2kg

Area of neck=2500mm^2

Area of tapered section=7500mm^2

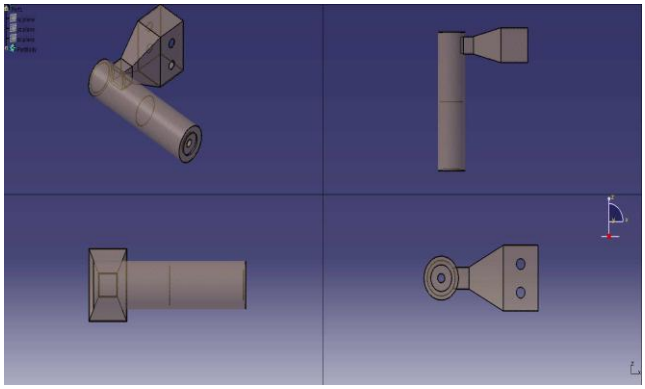

Figure 3: 3d View of main cylinder with Hopper

Main Cylinder Specifications:

Length of main Cylinder=400mm

Length of tapered section=195mm

Length of non-tapered section=200mm

Diameter of main cylinder=80mm

3. Housing 1 & 2:

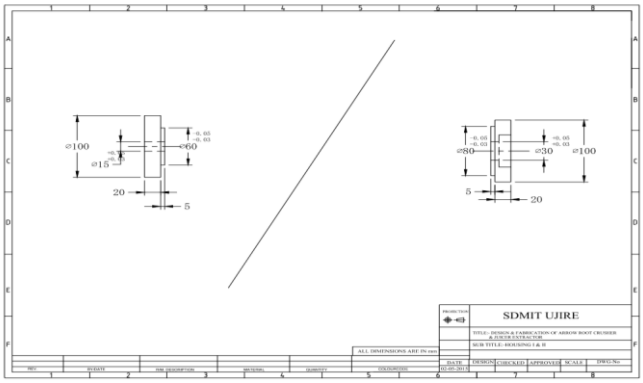

Figure 4:2d View of Housing

4. Stirrer or Feed screw

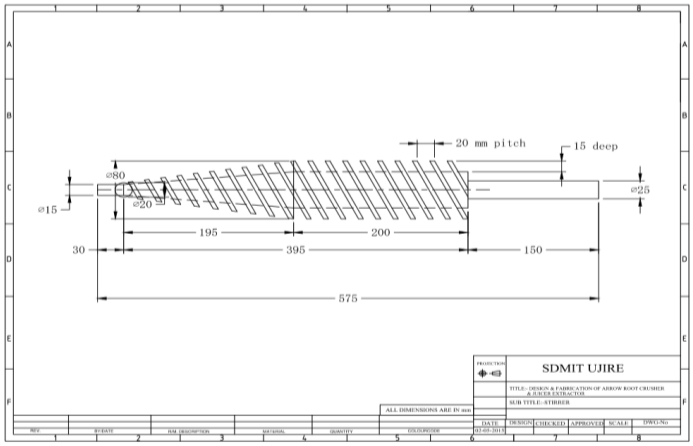

Figure 5:2d View of Stirrer or Feed Screw

Specifications:

Pitch=20mm

Length of tapered section=195mm

Length of non-tapered section=200mm

Diameter of larger section=80mm

Diameter of smaller section=15mm

Depth of groove=15mm

Length of handle=150mm

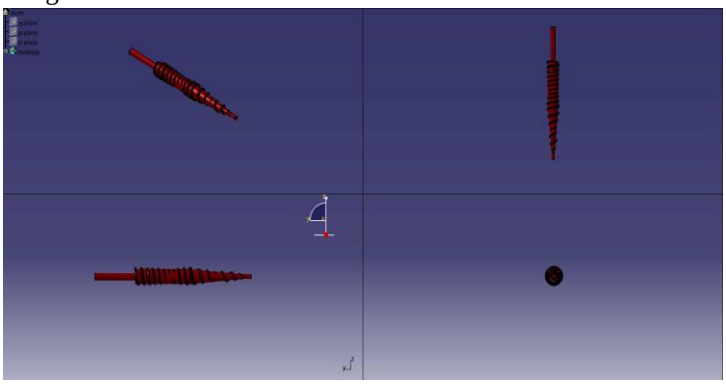

Figure 6:3d View of Stirrer

5. Tray:

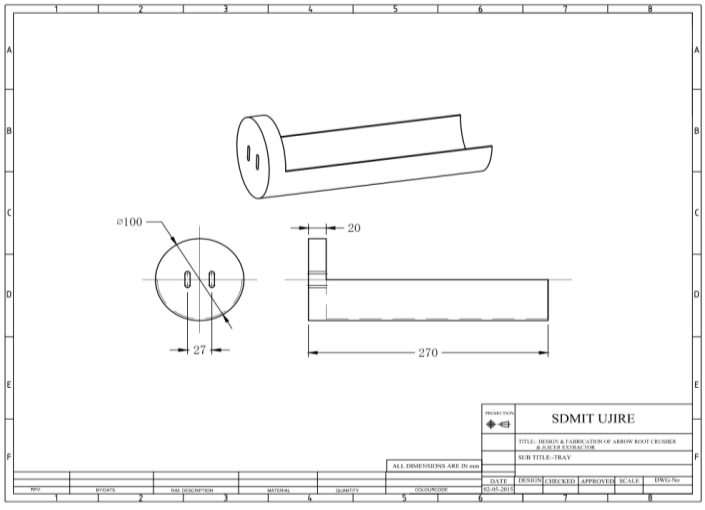

Figure 7:2d View of Tray

6. Cutter

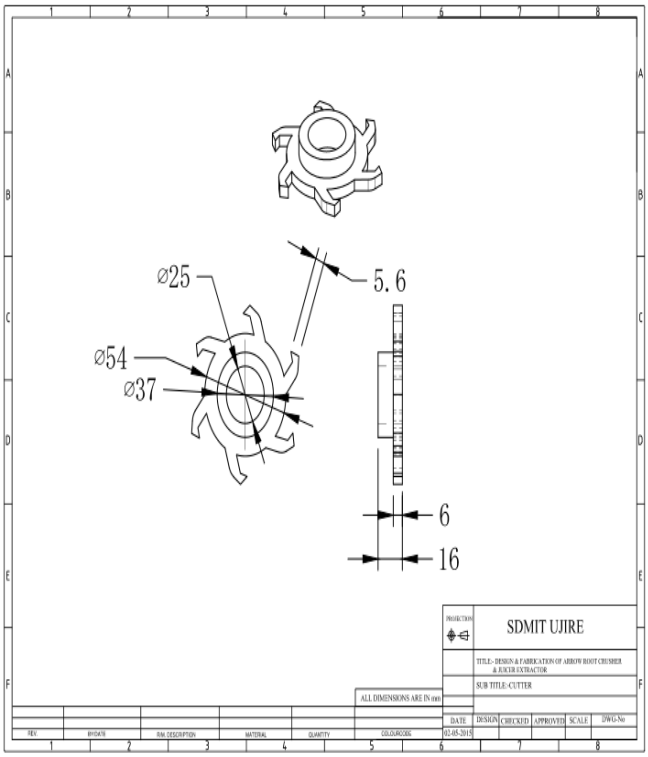

Figure 8:2d View of Cutter

Specifications:

No of blades=8

No of teeth in each blades=6

Thickness of blade=6mm

Thickness of inner shaft=10mm

Diameter of hole=25mm

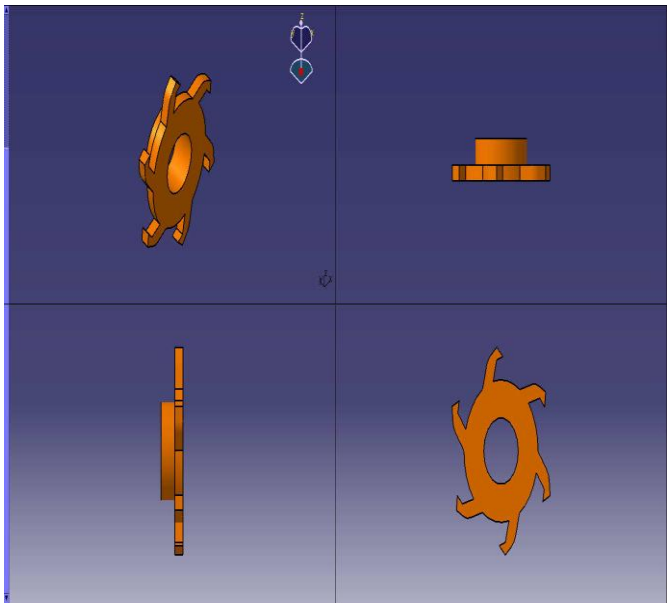

Figure 9 :3d View of Gear

7. Sprocket:

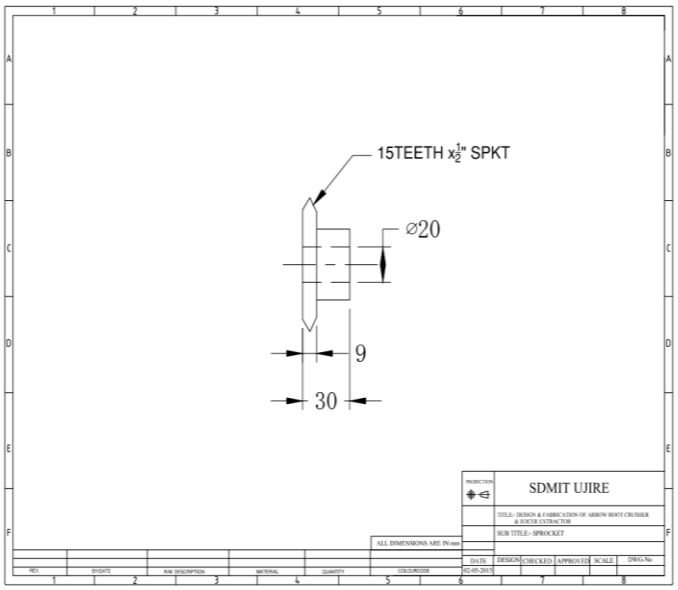

Figure 10:2d View of Sprocket

8. Gear:

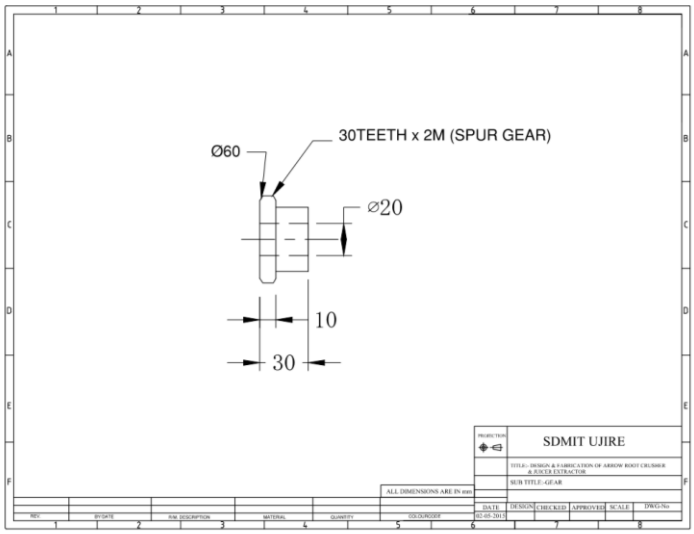

Figure 11:2d View of Gear

Specifications:

No of teeth=30

Diameter of hole=20mm

Thickness=30mm

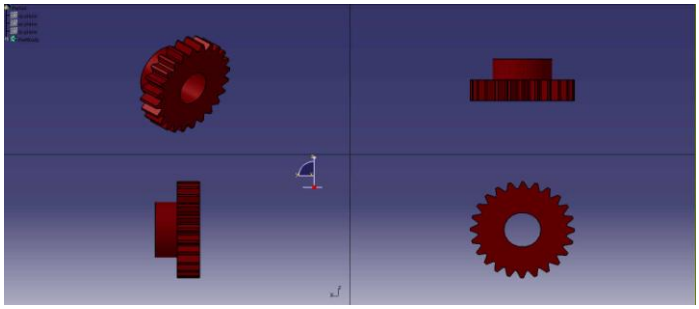

Figure 12:3d View of Gear

III FABRICATION

Figure 13: Assembled view

The main parts of Arrowroot juice extractors are Base frame, Body, Cutter, Hopper, Feed Screw, Drives and a Motor. The heavier base frame is made up of mild steel which is welded and joined together to support the entire structure. The body part machined using the CNC machine to obtain the larger hole where feed screw is inserted. The body part is also welded with the hopper for arrow root feed. The body is having inner tapered hole to accommodate the tapered feed screw. Hole is provided for the entry of arrowroot from hopper. Hopper is machined and welded to the body. The Feed screw is machined carefully using the CNC machine to obtain the tapered cylindrical shape so that it can carry the pulp to the other end of the body. Feed screw is inserted inside the tapered body carefully from one end. Motor is connected to feed screw using coupling shaft. So as to transfer power to the feed screw to rotate and provide juicing action. The cutter is provided at the top of the hopper and it is belt/chain driven and the chain is connected to the motor. The entire part is made of mild steel and the parts are carefully painted to avoid rusting of the parts. The body is provided with a hole at the bottom other end for the removal of juice. The body is also provided with holes perpendicular to the bottom hole for the removal of pulp The pulp will be carried to the other end and removed.

The carefully selected fresh arrow roots are peeled properly. The peeled arrowroots are washed in water and cleaned all dust from it and introduce it into the hopper. The first stage is cutter which is driven using chain with help of a motor. This cutter breaks the root into small pieces with the help of the sharp blades attached to it. These small pieces of arrow root moves to the next stage which is a feed screw which has spiral teeth in it. When arrow root fall on these feed screw they get squeezed which leads to produce juice which flows through the hole provided in the body of the extractor and the fruit or the pulp by the feed screw spiral teeth to the other end of the body and it passes through the small holes provided in the horizontal position of the body. The feed screw is rotated by the motor coupled to it. The cutter uses the same motor that is used for the feed screw. The pulp will move inside the hole provided in the body. This pulp is removed further manually. The juice extracted is flown in an inclined carrier which carries the juice to the collector.

IV RESULTS AND OBSERVATIONS

1.Material Removal Rate:

MRR= v.d.b Eq….4.1

Where,

v= work piece velocity=Ignoring this

d= depth of cut=2mm

b= width of cut=6mm

From Eq 3.2

MRR =0.002*0.006

=0.000012m

2.*Cutting Power (Milling):*

$$Pc=\frac{d * w * f}{60*10^6*E} * Kc \quad \text{Eq….4.2}$$

Where,

Pc=Cutting Power in kw.

w=width of Cutting Power in kw.

d=depth of cut=2mm

w=width of cut=6mm

f=table feed=100mm/min

Kc=specific cutting force

E=Machine Coefficient=80% (assumed)

From table for mild steel

Kc=2200

From Eq 3.2

$$Pc=\frac{2*6*100*2200}{60*10^6*0.8}$$

Pc=0.06 KW

1 KW=1.34 HP

$\therefore$ Pc=0.08 HP

3.Spindle Speed

$$N=\frac{1000*Vc}{\pi*D} \quad \text{Eq….4.3}$$

Vc=Cutting Speed=100m/min [assume]

D=Diameter of Cutter=60mm

From Eq 3.3

$$N=\frac{1000*100}{3.14*60}$$

$$=\frac{10^5}{188.4}=530.78\text{rpm}$$

4.Feed per Revolution

$$Fz=\frac{f}{z*n} \qquad \text{Eq}\ldots.4.4$$

z=number of teeth =6

From Eq 3.4

$$Fz=\frac{100}{6*530.78}=0.1\text{mm/rev}$$

5. Comparing the above phenomenon with grinding process with a rotary grinding tool

For rolling contact

The chip length

$$L=\sqrt{Dd} \qquad \text{Eq}\ldots.4.5$$

D=Wheel Diameter=60mm

d=depth of cut=2mm

From Eq 3.5

$$L=\sqrt{0.06}*\sqrt{0.002}$$

=0.011m

V CONCLUSIONS

The arrow root juice extractor can be used for continuous production of juice and pulp from the arrow root. It can also be used for various other kind of fruits to produce juice and pulp. The entire body is made up of mild steel instead of stainless steel. The mild steel is heavier but strong enough to withstand various forces acting on it. The machine can be used for mass production which reduces the cost even if the initial cost is high. The materials were available locally and with affordable cost. The machine was assembled to produce pulp and juice separately but because of low groove angle the pulp and juice flows in same side. The future work of improvement in the groove angle can produce the pulp and juice in the separate sections of the machine. Future work can also include the pedal to drive the machine without motor which can reduce high cost of the motor.

REFERENCES

[1] Proceedings of the World Congress on Engineering 2012 Vol III WCE 2012, July 4 - 6, 2012, London, U.K.

[2]Journal of Agricultural Technology 2011 Vol. 7(4): 931-944 by Olaoye, J. O.

[3] Sasi Kumar R, Ray RC, Paul PK, Suresh CP (2013) Development and Storage Studies of Therapeutic Ready to Serve (RTS) Made from Blend of Aloe vera, Aonla and Ginger Juice. J Food Process Technol 4: 232.

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