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Development of lab scale pineapple fruit juicer

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■ **ABSTRACT :** Pineapple is the third most important tropical fruit in the world after banana and citrus fruit. This fruit is highly perishable and seasonal.Juice extraction is the process by which the liquid potion of the fruit is been squeezed or forced out of the solid part of the fruit either by manual or mechanical.Automatic pineapple juicer machine can do all the process required to produce the pineapple juice that means core of the pineapple can be crushing by the machine and the pomace and juice is separated differently. In this machine we firstly cut the fruit by using rotating knife and these fruit cubes are passed through squeezing mechanism in this screw shaft rotating and juice separate and pomace are separate. In this determination of physical properties like dimensions (Length, Width, Thickness), Geometric mean diameter, sphericity, size shape, surface area and density were determined. Average length, width and thickness were 164.8 mm, 87.12 mm and 88.9 mm, respectively. Average weight of pineapple fruit was 898.8 g. Size, shape, density and sphericity of pineapple fruit were 109.68, 53.38, 1.394 and 0.64, respectively. The average is taken the weight of fruit (g), weight of waste (g), weight of juice (g) are 1191.5, 318.6 and 826.1, respectively. On this observation we come to know that juice yield (%), extraction efficiency (%), extraction loss (%), are 71.09, 70.15, and 3.91were taken, respectively. The RPM is 2800. Powered by a 0.35 HP single phase electric motor, the machine has a capacity of 18.90 kg/h.

■ **KEY WORDS :** Fruit juice, Juice extractor, Physical properties, Pineapple, Pomace

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Pineapple [*Ananas comosus* (L.) Merr.] Family: Bromeliaceae is one of the most important commercial fruit crops in the world. It is known as the queen of fruits due to its excellent flavour and taste. Pineapple is the third most important tropical fruit in the world after banana and citrus. Pineapple fruits are an excellent source of vitamins and minerals.The pineapple fruit needs more force than other fruits for extraction because of its thickness of fruit skin.Traditional methods are still employed in the extraction of juice from fruit.Juice extraction is the process by which the liquid potion of the fruit is been squeezed or forced out of the solid part of the fruit either by manual or mechanical means. Small scale pineapple juice extractors are highly essential in the processing of pineapple fruit to the form that can easily be preserved for longer period. Small scale extractors can easily be afforded, operated and maintained by low income and small scale entrepreneurs. The major component parts of the extractors are made of stainless steel and are mechanically driven by an electric motor. There are two principal methods of juice extraction from fruits. In the first method, the fruits are crushed and pressed continuously in a single operation. In the second method, fruits are sliced into smaller pieces and then processed by a suitable pressing machine to extract the juice.

METHODOLOGY

The main purpose of developing lab scale pineapple fruit juicer is for high efficiency, less damage, low cost and for easy handling.

Design considerations :

The following factors were considered in the design of the pineapple juice extractor:

– Availability and cost of construction materials.

– Slicing and extraction unit were design with stainless steel to avoid contamination of juice.

– The hopper was designed to accommodate the required quantity of pineapple fruits and the slicing and the extraction units for high efficiency.

– Other consideration included the desire to make the extraction chamber and juice outlet with stainless steel to ensure the quality and safety of juice, and to design the extraction chamber to accommodate the required quantity of pineapple fruit.

– Taper screw conveyor was adapted to ensure maximum crushing, pressing and easy conveyance of the sliced pineapple lumps, to enhance high extraction efficiency.

– Designed for strong main frame to ensure structural stability and strong support.

– Easily operated.

– Cheaply and easily manufactured with local resources.

– Easily maintained.

Materials required for development of pineapple fruit juicer :

Stainless steel :

The shaft, knife, outer chamber, hoppers, sieves are made of stainless steel.

- Properties of stainless steel
- It is hard and strong substance
- It is not a good conductor of heat and electricity
- It has high ductile strength
- It does not get oxidized easily
- It is highly resistant to corrosion
- It is capable of retaining its strength
- It possess magnetic permeability

Mild steel:

Main frame, motor.

- Properties of mild steel
- Mild steel is a great conductor of electricity. So it can be used easily in the welding process.
- Mild steel can be easily machined in the lathe, shaper, drillling or milling machine. Its hardness can be increased by the application of carbon.
- Mild steel is very much suitable as structural steel. Different automobile manufacturers also use mild steel for making the body and parts of the machine.

Parts of fruit juicer :

Feed hopper :

It is a part of fruit juicer which is made up of galvanized metal. At top it is round in shape the material used in this part is galvanized material. The working of this hopper I that the stationary part it is mounted on the chamber which forms into the feeding chute.

Chamber:

It is the outer most part of the fruit juicer which contains the shaft. It is made up of stainless steel material. This will play main role in cutting of the fruits in the equal medium sized so that the juice is cleared and it helps to extract the juice easily.

Shaft:

Shaft is important part of the fruit juicer which is made up of stainless steel solid bar. The stainless steel part is drilled and knife is inserted with nuts bolts. So that during process it knife is damaged then we can separate it from the shaft easily.

Screw shaft:

The screw shaft is the other most important part of pineapple fruit juicer which is conveying, crushing and pressing unit of the machine. This is a rotating part of the system.

Machine frame:

The machine frame is made up of mild steel which is attached by screw shaft and one motor is fitted. As the motor rotates the juice is collected at one side and waste part fruit is collected at the other side of the frame machine. The two design factors considered in determining the material required for the frame are weight and strength. This frame machine supports all the material and also carries the weight of the machine as well as component.

Juice collector:

The juice collector is made of plastics bowl which helps collect juice from the crushing chamber and it is attached under the crushing chamber.

Waste collector:

The waste collector is made of plastics bowl which helps to collect the pomace of pineapple. It is attached under the crushing chamber.

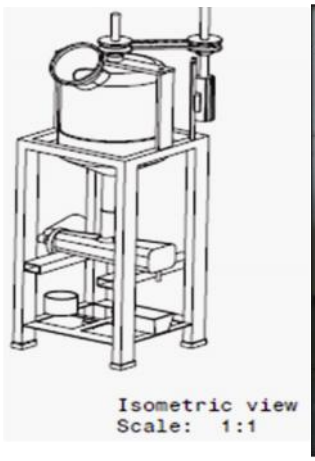

Fig. A : Sehematic diagram of pineapple fruit juicer

Fig. B: Developed pineapple fruit juicer

Working methodology of prototype of developed lab scale pineapple fruit juicer :

Firstly the pineapple is passed through the hopper and then it is transferred to the stainless steels chamber. Which is fixed with shaft and the shaft is attached with stainless steels knife due to which when the fruit is passed through the hopper at that time shaft is rotated. All this process is carried out of 0.35Hp motor which is fixed at the top of the equipment. With the help of this motor shaft is rotated and due to rotation of shaft the fruit is cut into small pieces. After that small cut pieces of pineapple is passed through the helical barrel, due to which the force is applied due to force pressing mechanism of fruit is carried out, after pressing juice and pomace are separated and collected at two different sides *i.e.* in two different plastic bowls. All this process is carried out by the waifer motor which is fixed at the middle of equipment and this motor runs on the 12V-4.5 Ah battery. This is over all working mechanism of pineapple fruit juicer.

Table A : Materials required for development lab scale pineapple fruit juicer

Sr. No.	Component	Material	Specification
1.	Hopper	Galvanized Iron	10 H x 18 W x 0.19 Thickness
2.	Chamber	Stainless steel	27 H x 12.5 W x 0.32 Thickness
3.	Shaft	Stainless steel	42 H x 12 Thickness
4.	Frame	Mild steel angle	62 H x 32 W x 32 L
5.	Crushing chamber	Aluminum	32 H
6.	Screw shaft	Brass metal	29 mm
7.	Pulley	Cast iron	3 mm
8.	V- belt	Rubber	A24
9.	Motor	Mild steel	0.35 Hp
10.	Battery	-	12 V-4.5Ah
11.	Ball bearing	Mild steel	14 mm
12.	Motor	-	0.35 HP (2800 RPM)

■ RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Performance evaluation of developed lab scale pineapple fruit juicer :

The performance indicators considered were percentage juice yield, extraction efficiency and extraction loss. Weight of raw material is measured on Digital weighing machine. Digital tachometer is used to check the RPM of Motor and reading displays on digital display. The performance evaluation of the juice extractor was carries out on the basis of the following indices used by Tressler and Joslyn (1961).

Juice yield :

$$J_y = \frac{100 \times W_{JE}}{W_{JE} + W_{RW}} \%$$

Extraction efficiency :

$$Ec\,\% = \frac{100 \times W_{JE}}{x\ W_{FS}} \%$$

Extraction loss:

$$E_l\,\% = \frac{100[W_{FS} - (W_{JE} + W_{RW})]}{W_{FS}} \%$$

Table 1 : Performance evaluation of pineapple fruit juicer

Sr. No.	Wt. of raw material (g)	Wt. of waste (g)	Wt. of Juice (g)	Juice yield %	Extraction efficiency %	Extraction loss %	RPM
1.	1260	282	930	76.73	73.78	3.80	2800

where,

W_{JE} is mass of juice extracted in g

W_{RW} is mass of residual waste in g

W_{FS} is mass of feed sample in g

x is juice constant of fruit in decimal.

Performance evaluation at 2800 RPM :

The third trial is taken on 1800 RPM; in this 2 fresh pineapple fruits were taken and cut by knife one by one then start the motor and set required RPM. Feed one by one slice into cylinder and observed weight of juice and pomace. The weight of fruit (g), weight of waste (g), and weight of juice (g) are 1260, 282 and 930, respectively. On this observations juice yield (%), extraction efficiency (%), extraction loss (%), are 76.73, 723.78 and 3.08, respectively. Similar work related to the present investigation was also conducted by Adebayo *et al.* (2014); Aju Adoni *et al.* (2016); Joy (2010) and Maria *et al.* (2014).

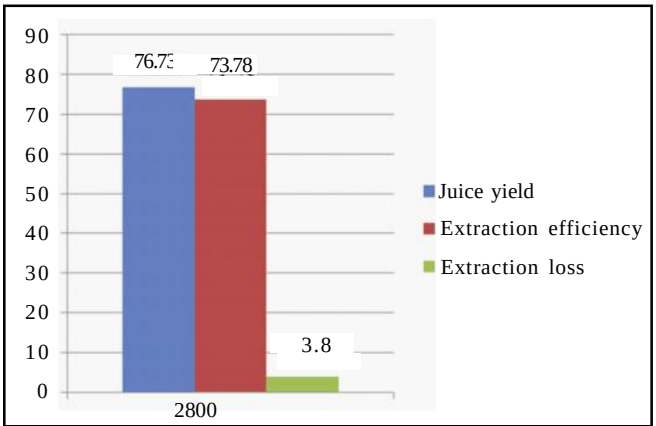

Fig. 1 : Graphical representation of third trial

Conclusion :

A small scale pineapple juice extractor was developed, constructed and tested. The extractor was portable enough for local production, operation, repair and maintenance. Results of the tests revealed a juice yield of 76.73 per cent with an extraction efficiency of 73.78 per cent, extraction loss 3.80 per cent. The RPM is 2800, respectively. Powered by a 0.35 hp single phase electric motor, the machine has a capacity of 18.90 kg/h with a production cost of 9350 rupees.

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