

## Design and Development of Aonla Pricking Machine

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### ABSTRACT

*Aonla* has the hallowed position in *Ayurveda*. *Aonla* is native to India and also grows at tropical and subtropical region like India, Pakistan Sri Lanka and Uzbekistan. In India Uttar Pradesh has the highest area under cultivation and production of *Aonla*. Area under *Aonla* orchard in Pratapgarh district of Uttar Pradesh is about 13000 hectares (Nitin Kumar *et al.*). *Aonla* is mostly used in making *murabba*, *pickles* and *candy* etc. Traditional method for making *Aonla murabba* is hygienic because for making *murabba*, *Aonla* has to be pricked first and that pricking method of *Aonla* is drudgery prone and most of the workers are injured by hand pricking method Also it takes too much time for pricking (Ganvir *et al.*). Till now *Aonla* is pricked by hand and power operated machine. Hand pricking of *Aonla* causes injury to the hands of the farm women and is a tiresome and slow process with low output capacity whereas the power operated machines are very costly and out of reach of medium and small farmers. Thus, to overcome these problems and keeping in mind the benefits of small and medium farmers a low cost, pedal operated *aonla* pricking machine suitable for farm women has been developed in the Department of Farm Machinery and Power Engineering, SHUATS, Allahabad. This machine is paddle operated with an output capacity of 3-3.5 q/h. No injury is caused to the farm women operating the machine. However the machine can be operated both by farm women as well as men farmers. Hopper of machine is containing 66 no. of *Aonla* at a time. Floor area used by this machine is 80 × 80 cm. Pricking needles, sieve plate and fruit plate used in this machine is made of stainless steel because of corrosion. Needles used in this machine are of 2 inches. 756 no. of needles are used in this machine. Maximum depth of pricking in *Aonla* is 7mm and max. dia of needle is 8mm. This machine is efficient for small and medium farmers

### Highlights

- *Aonla* pricking machine was developed for small and medium farmers. This machine was used for pricking *Aonla*. This machine has capacity to prick 3-3.5 qt *Aonla* in a hour which is too good in comparison to hand pricking. It has high in capacity and negligible in human drudgery.

**Keywords:** *Aonla*, drudgery, *Ayurveda*, pickles, *murabba*

*Aonla* has a hallowed position in *Ayurveda*. *Aonla* is also known as (*Phyllanthus emblica*) or Indian gooseberry. *Aonla* is native to India Uttar Pradesh has the highest area under cultivation and production of *Aonla* in India. *Aonla* has been used for making *murabba*, pickles, candy and many more products (Ghuge *et al.*) *Aonla murabba* is an Ayurvedic medicine and Indian recipe used for gastric problems and as general health tonic. It is rich in Vitamin c and other essential nutrients and antioxidants (Goyal *et al.*). The fruit of *Aonla* has average diameter of 38.80 40.96 mm (vertical) and

33.28 to 34.81 (horizontal). Average weight whole fruit, seed and pulp are 31.80 to 37.76 g respectively. Specific volume and specific gravity of fruit were 29.50 to 33.47 ml and 1.17 to 1.13 respectively (Kulkarni *et al.*) Conventional method used for punching *Aonla* is unhygienic in nature, increase injury probability and Automatic pricking machine is high in cost which is out of reach from small and medium farmer. This paper indicates capability of Machine to prick *Aonla* to overcome problems like high cost of machine, unhygienic nature, injuries

of worker. This machine mostly used by small and medium farmers.

### Objective

To design and develop a paddle operated *Aonla* pricking machine for reducing drudgery and injury to farm women.

### MATERIALS AND METHODS

Fully mature *Aonla* fruit were harvested from SHUATS orchard and stored in cool place before conducting experiments. All the experiment was conducting at the room temperature at (27±2C). All the physical parameters were studied prior to check the machine performance.

**Physical parameters of *Aonla*:** Physical parameter of *Aonla* was obtained from heap of *Aonla*. 10 *Aonla* was randomly selected from heap of *Aonla* then physical parameter like Diameter, Weight and surface area of *Aonla*.

**Diameter of *Aonla*:** Diameter of *Aonla* was measured by vernier caliper (least count 0.01 mm). 10 no of *Aonla* was randomly selected from heap of *Aonla*. *Aonla* has average diameter of 36.80 42.96 mm (vertical) and 32.38 to 36.72 (horizontal).

**Weight of *Aonla* :** Weight of *Aonla* was measured by weighing machine least count (0.1 g).

**Surface area of *Aonla* :** It is calculated by sphericity.

**Sphericity :** The sphericity is a measure of shape character compare to a shape of same volume. Assuming the volume of solid is equal to the volume of tri-axial ellipsoid with intercept a, b, c and the diameter of circumscribe sphere is largest intercept of the ellipsoid, the degree of sphericity was calculated as follows:

$$DS = \frac{\sqrt[3]{a \times b \times c}}{a} \text{ (Nitin Kumar et al.)}$$

Surface area of sphere =  $4 \times \pi \times r^2$

**Pricking efficiency:** Pricking efficiency was calculated by ratio of pricking surface of *Aonla* to surface of *Aonla*.

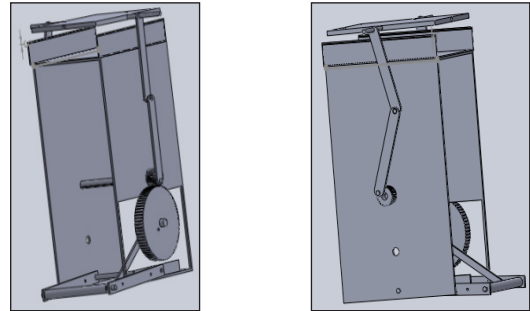
$$\text{Pricking efficiency} = \frac{\text{Pricking surface of Anola}}{\text{Surface of Anola}}$$

**Maximum depth of pricking :** Maximum depth of pricking is calculated after pricking of *Aonla*. *Aonla*

was cut by knife and measure the depth of pricking by vernier caliper (least count 0.01 mm).

### Machine design

Firstly machine design was developed in mechanical software solid works. The design that was generated in software has an assumed dimension of paddle operated *Aonla* pricking machine.



**Fig. 1:** Right view and Left view Machine design in solid works

### Selection pf Machine Part

#### Frame

Frame is the base part of machine. Frame was of load bearing material The material was a mild steel 30mm wide and 3 mm thick L-angle. The angle was cut by cutter in 100 cm length and welding by electric arc welding. Frame has length breadth and height 60×40×100 cm respectively.



**Fig. 2:** Frame

**SPIKE PLATE:** Spike plate has an upward and downward motion to prick *Aonla*. Spike plate is made up of mild steel. Spike plate has 756 no. of

holes of 10 mm diameter with the dimension of plate 40×60 cm.

### Needles

Needles used in machine for pricking *Aonla*. Needles have 8mm maximum cross section area. The plate contains 756 no of needles of stainless steel to prevent corrosion. By remembering the depth of pricking and easy of rolling of *Aonla* on fruit plate length of needle was 2 inches used.

### Seive Plate

It is also made up of stainless steel. It is used for preventing lifting of *Aonla* by needles after pricking sieve plate is of 40×60 cm. gap between each rod of steel was 1.5 cm. 18 no. of stainless steel rod were connecting in sieve plate.

### Gears

In this machine spur type gears are used. Three gears are used in this machine 2 gears are used for balancing needle plate and remaining one is used to giving reciprocating motion. Gears teeth are move in to and fro motion. Small gears have 50 no. of teethes and large gear have 100 no. of teethes.



Fig. 3: Gears

### Balancing Weight

It is the heart of machine. it is used to lifting paddle automatically. With the help of balancing weight "machine work in to and fro motion". Balancing weight has 8cm cross section area 12 cm height and 10 kg weight.



Fig. 4: *Aonla* pricking machine

## RESULTS

About 10 *Aonla* fruits of Banarasi variety and average 50 mm diameter were randomly selected for testing. Depth of pricking of *Aonla* is measured by vernier caliper. The rate of pricking *Aonla* was 3-3.5 q/hr as shown in table 1&2.

Table 1: Parameters of *Aonla*

Sl. No.	Weight in (gm)	Surface area of <i>Aonla</i> pricking (mm <sup>2</sup> )	Maximum depth	Pricking efficiency
1	27.07	4519.85	5	20.4
2	31.60	4680.89	7	19.74
3	31.10	4603.63	7	20.07
4	31.95	5155.47	8	19.86
5	34.04	5655.62	8	19.96
6	25.60	4439.21	8	20.8
7	26.40	4496.06	8	20.55
8	32.26	5381.83	8	20.97
9	31.75	4666.36	8	21.9
10	23.98	4282.41	7	21.5

Table 2: Testing of machine

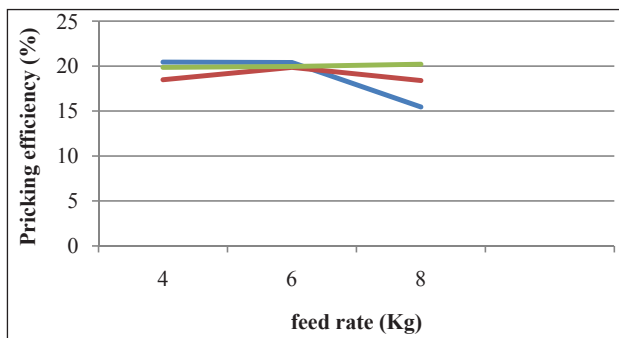
Feed rate (kg)	Diameter (mm)	Depth of pricking (mm)	Pricking efficiency (%)	Output capacity (kg)	Losses (no. of <i>Aonla</i> )
4	38	5	20.45	370	2
	40	7	18.49	365	3
	42	7.5	19.86	355	5

6	38	6.5	20.4	340	2
	40	7.2	19.86	342	2
	42	7.9	19.96	340	3
8	38	5	15.46	370	5
	40	7.2	18.40	371	6
	42	7.5	20.21	372	5

**Output capacity:** Output capacity of machine is calculated according to feed rate of *Aonla* by time. Means *Aonla* prick in machine per hour is known as output capacity of *Aonla* pricking machine.

**Losses of *Aonla*:** losses of *Aonlas* are calculated in natural numbers. losses of *Aonla* was depend on feed rate and size of *Aonla*.

Table 3 was show pricking efficiency, output capacity, and losses of *Aonla* by feed rate 4kg, 5kg, 6kg with the diameter of 38 , 40, 42 mm. As we seen that depth of pricking was depend on diameter of *Aonla*. Means max. Diameter has max. depth and min. diameter has min. depth.



**Graph 1:** Aonla pricking feed rate

This graph show that the feed rate of *Aonla* 6 kg/min was much better for pricking.

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