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Ajay Kumar Swarnakar
Agricultural and Food
Engineering Department, Indian
Institute of Technology
Kharagpur, Kharagpur, West
Bengal, India

Rakesh Kumar Bathre
Post-Harvest Process and Food
Engineering Department, College
of Agricultural Engineering,
Jawaharlal Nehru Krishi Vishwa
Vidyalaya, Jabalpur, Madhya
Pradesh, India

Shriprakash Shrivastava
Post-Harvest Process and Food
Engineering Department, College
of Agricultural Engineering,
Jawaharlal Nehru Krishi Vishwa
Vidyalaya, Jabalpur, Madhya
Pradesh, India

Correspondence

Ajay Kumar Swarnakar
Agricultural and Food
Engineering Department, Indian
Institute of Technology
Kharagpur, Kharagpur, West
Bengal, India

Design and development of Aonla stone (Seed) removing cum slicing equipment

Ajay Kumar Swarnakar, Rakesh Kumar Bathre and Shriprakash Shrivastava

Abstract

Aonla is a popular and medicinal fruit in India. Aonla seed stone needs to remove before the preparation of the value-added product like pickle, murabba, etc. traditional method of seed removal is softened the pulp by boiling before the separation of seed. This method reduces the nutritive and sensorial quality, and make undesirable changes some time in physical properties. In this work, an attempt was made to develop equipment for removing the aonla stone and slicing pulp for small-scale and household purpose. The capacity of the equipment was found 12 to 14 kg/h. this capacity of aonla slicing and destoning was about 10 times greater than the manual operation.

Keywords: aonla, aonla stone, equipment, tool, slicing

1. Introduction

The aonla belongs to EUPHORBIACEOUS family. Aonla is known as Indian gooseberry. It is an important fruit crop of the tropic and subtropic region in India. It contains about 600 mg of vitamin C in 100 g of aonla pulp along with 0.88 g protein, 0.54 g pectin, 0.55 g thiamin (Goyal *et al.*, 2008) [4]. Aonla is also rich in mineral, fiber and other vitamins (Tripathi *et al.*, 1988) [5]. That is why it is used in traditional system of medicines like ayurvedic and unani due to its therapeutic value. The Aonla fruit is used in medicines to treat the common cold, gastric troubles, headache, constipation, enlarged liver etc.

Aonla is grown in all parts of India. In India, it nearly covers 50,000 hectares. Out of area with annual production of 200000 metric ton (Goyal *et al.*, 2008) [4]. In India, U.P. ranks first in both area and production. It covers about 15750 ha. The area under aonla cultivation production is about 63000 tones (Anonymous, 2018) [2]. It is grown in all over in Asia for its nutritional, pharmaceutical and commercial significance. Aonla is available only during season's late for 4 to 5 months is and therefore the products made out of it, use preservation for longer shelf life. The main popular varieties of Aonla are NA-7, NA-6, Banarsi, Chakaiya, Francis Krishna, and Kanchan.

Medicines product like chyvanprash, syrup, hair oil, aonla powder is also for human use (Goyal *et al.*, 2007) [3]. The fruit has very limited scope due to its astringent taste. However, aonla fruit is processed into a number of products like preserve candy, pickles, juice, shreds, RTS, beverage dried powder etc. are been popular. Aonla based medicines are useful in chronic disease e.g. dysentery, bronchitis, diabetes, fever, cough etc. there is a broad scope of its products for human health (Agarwal and Chopra, 2004) [1].

Aonla is used in India as value added product like pickles, squash, sauce, 'Murraba' powder, dehydrate slice of aonla (with or without spice & salt) other preservative forms etc. in India method employs are based on traditional knowledge of past. These methods are unhygienic in nature and time-consuming. The nutritional loses in these methods. These methods are costly laborious and produce contaminants quality of product. There is also a danger of minor accidents during manual pricking, stone removing and shredding. Methods Like in boiling nutrient and juice accrue surface hardness, pulp hardness type mechanical properties are also influences which are unsuitable for some processing process. The shelf life of the prepared product was also less and the quality not up to the mark. For the preparation of pickle and other products first of all fresh aonla has boiled, then the stone is removed by manually with the help of the knife. Now a day's urban city also prefers various preparation of Indian gooseberry.

At present, there will be need of a tool which will remove the aonla stone from the aonla fruit. So, the present work is design and develop a tool for removing aonla stone and slicing.

2. Material and Methods

2.1 Raw material

Aonla stone remover cum slicing equipment development work was carried out with local market available varieties from Jabalpur district. The development of aonla stone remover was fabricated in the workshop of Post-Harvest Process and Food Engineering Department in the College of Agricultural Engineering, Jawaharlal Nehru Krishi Vishwa Vidyalaya Jabalpur.

2.2 Design consideration

This section deals with the design and consideration for the designing and development of the aonla stone removing cum pulp slicing equipment cutting equipment and aonla resting seat. The components of the cutting tool are connecting bolt, solid cylinder, penetrating rod, and cutting blade. These were the important component of equipment.

2.2.1 Connecting bolt: This section deals with the design and consideration for the designing and development of the aonla stone removing cum pulp slicing equipment cutting equipment and aonla resting seat. The components of the cutting tool are connecting bolt, solid cylinder, penetrating rod, and cutting blade. These were the important component of equipment.

2.2.2 Penetrating rod: The diameter of the penetrating rod depends upon the geometric mean diameter of stone, and the length of the penetrating rod (L_R) (eq. 1) depends upon the length of aonla fruit and is as follows:

$$L_R = L_a + S_r \tag{1}$$

Where,

L_R = length of penetrating rod

L_a = length of aonla fruit

S_r = clearance between the cutting blades and aonla resting seat

Clearance is provided for the smooth operation and protection for fruits slices. Diameter of penetrating rod and aonla fruit stone was almost equal.

2.2.3 Cutting blade: Cutting blade of width, thickness, and length was taken as it sufficient to cut the aonla pulp. The dimensions of the blades are as follows:

Thickness of the blade $T_B = 2$ mm (based on material availability)

Length of the blade (L_B)

$$L_B = L_a + S_r + S_w \tag{2}$$

$$L_B = L_a + S_r + S_w$$

Where,

L_a = length of aonla

S_w = Space for welding in head cylinder

Width of blade (W_b)

$$W_b = \frac{1}{2}(D_{gm} - D_r) + S_b \tag{3}$$

Where,

D_{gm} = geometric mean diameter

S_b = increase of the blade

2.2.4 Aonla resting seat

Aonla resting seat was used for keeping aonla in plate from a hole is provided for removal of stone (Fig. 1).

2.2.5 Hole

Hole is used for the process of removing of aonla stone and provides passage for stone.

$$D_h = D_{sm} \tag{4}$$

Where,

D_h = diameter of hole

D_{sm} = geometric diameter of aonla stone

2.2.5 Semi spherical concave surface

Semi spherical concave surface was providing for keeping aonla in rest position for operation. The diameter of concave surface was just greater than the diameter of aonla.

2.2.6 Grooves: Grooves in the aonla resting seat were provided for the purpose of proper penetration of blade in aonla pulp.

$$\text{Length of groove } (L_g) = (W_b + D_r/2) - D_c/2 \tag{5}$$

Where,

D_c = diameter of surface

The material was used to fabricate cutting tool is mild steel and it has been coated by nickel polish so it becomes well anti corrosive properties against most of corrosive media as well as hygienic.

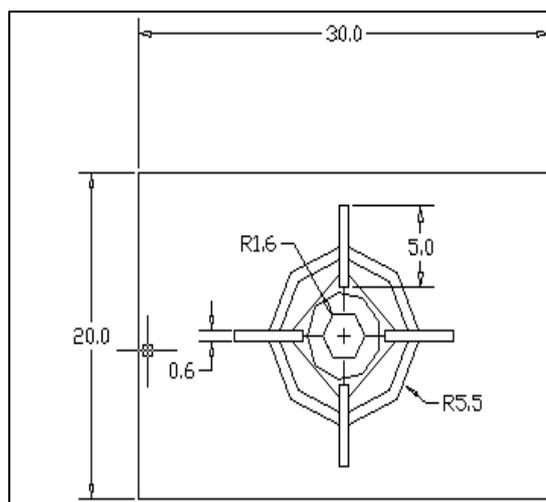


Fig 1: Plane view of aonla resting seat (dimension in cm)

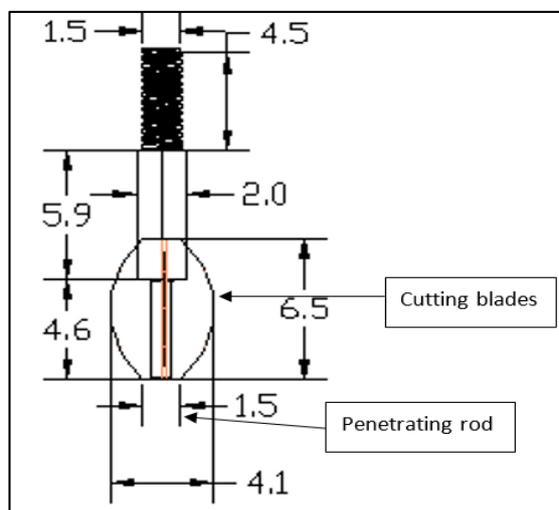


Fig 2: Cutting Tool (Dimension in cm.)

3. Results and Discussion

3.1 Manually aonla stone removing cum pulp slicing equipment setup

Experimental setup of the manually aonla stone removing cum pulp slicing equipment consist of aonla resting seat cutting tool, push lever, stand and stone collecting unit (Fig. 3). The cutting tool was made of mild steel with nickel coating protect the tool against the corrosion and blacking of aonla. Aonla resting seat hole and grooves were provided for the purpose of keeping aonla in position for punching seed and pulp slicing. The two-dimensional diagrams are shown in figure 1 and 2. For detail of tool and aonla resting seat figure shown of the cutting tool and aonla resting seat (Fig 3). Cutting tool can be pressed with the help of a handle and shaft which have the internal thread. These are joint the cutting tool on a mild steel angle. After the removing of the seed; seeds were collected in a collecting tray with the suitable passage.

The overall dimension of the whole equipment was 100.7×47×47 cm³.

3.2 Working process

The process of removing stone (seed) and slicing of aonla pulp begins with the setting of the cutting tool and the keeping aonla in the resting seat. Afterwards, a stone collecting tray put below the hole of the aonla resting seat. The sudden force was applied to the handle after connecting the cutting tool in the handle. Due to this action penetrating rod penetrated the fruit and pushed the stone to aonla at that time blade of the tool also sliced the aonla pulp in 4 slices. Then again pick an aonla fruit and put on aonla on resting seat and repeat the same process as mentioned. Stones were collected in stone collecting tray and aonla pulp was collected manually. The working process is depicted in Fig 4.



Fig 4: Manually operated aonla stone removing cum pulp slicing equipment while working



Fig 5: Sliced aonla from manually operated aonla stone removing cum pulp slicing equipment

3.3 Performance of aonla stone removing cum pulp slicing equipment

3.3.1 Pulp loss

Pulp loss occurs due to penetration rod and aonla seat hole. Sudden load on the handle of equipment remove the stone and slice the pulp. But simultaneously penetrating rod took the upper and lower portion of aonla fruit pulp with stone which is equal to the diameter of the rod and stone, respectively. This pulp considered as pulp loss as it was separated from the slice and not in the desired shape and size. The average loss was estimated about 10.05%.

3.3.2 Pulp recovery compare to manually removed stone and slicing

In the manually operated aonla stone cum slicing equipment, whole pulp was not found because of the pulp loss as mention table 1. The pulp recovery was found 89.89%.

Table 1: Performance of aonla stone removing cum pulp slicing equipment

Experiment Number	Number of aonla	Wight (g)	Total pulp (g)	Pulp recovery %	Pulp loss %	Time taken
1	26	1113	1058	90.5	9.45	4 min 30 s
2	28	1067	1015	89.65	10.3	4 min 50 s
3	29	1038	978	89.5	10.4	4 min 58 s

Table 2: Manual stone removing and pulp slicing of aonla

Experiment number	Number of aonla	Wight (g)	Total pulp(g)	Pulp recovery %	Pulp loss %	Time taken
1	27	1104	1054	99.5	0.5	52 min 12 s
2	24	1012	960	99.54	0.46	59 min 38 s
3	30	1030	980	99.45	0.55	54 min 31 s

In manually stone removing and slicing of aonla take more time as compare to aonla stone removing cum pulp slicing equipment (Table 1 and 2). It takes about 1 h for 1.2 kg which is more time consuming and hand working process. As mention in Table 2.

3.4 Capacity

The aonla stone remover cum pulp slicing equipment can operate by only one person. The aonla stone remover cum slicing equipment capacity nearly 12 to 14 kg/h. While manually removing of stone and slicing of aonla pulp it takes about one h for every 1.2 kg. So, it is clear that aonla stone removing cum slicing equipment decrease the manual effort and time of operation. It is useful in the preparation of aonla value-added products at small scale. Stone of aonla removed from this equipment can be used for plantation as well but in case of boiling it is not possible.

4. Conclusion

The aonla stone removing cum slicing equipment is useful for preparing the value-added product like pickle, murabba, dry slice etc. This equipment decreases the time of operation and effort of slicing. Thus, the equipment operator takes less time and less effort over the manual. The obtained product was more hygienic as compare to manually removed pulp. Therefore, it will be very useful and also have low-cost technology for household and small-scale use.

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