Status of technological developments in processing of Aonla fruits and seeds: Review

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Abstract

India is second largest producer of fruits and vegetables in the world and is leader in various fruits and vegetables area and production. Due to perishable nature of horticultural produce their value addition is the prime necessity to preserve them for long time at the time of glut and to make them available in off season. Their processing needs advanced mechanization and new processing methodology to be developed for ease of harvesting, handling, processing and storage to reduce the human drudgery. India ranks first in the area under production and productivity of aonla or Indian gooseberry (Emblica officinalis Gaertn). It belongs to genus Emblica of the family Euphorbiaceae and order Euphorbiales. It is well known Indian fruit for its medicinal and therapeutic properties from the ancient time in India. Aonla fruit is perishable and thus needs to be processed after few days of harvesting or else immediate marketing of raw a fruit is required. Raw aonla fruit is not much acceptable by consumers because of its high acidic nature and its astringent taste. But the aonla products like candy, supari, pickle, preserve, chavaprash are very famous and have huge demand in the market because of their health benefits. Wide research has been carried out for development of equipment and machineries for aonla processing. Present article contains review of different technologies like aonla stone removing machine, aonla prickling machine, manual aonla stone removing cum slicing machine, aonla segmenting machine and aonla punching machine available for processing of aonla fruits.

Keywords: Aonla fruits, equipments, machineries, review

Introduction

Aonla, (Emblica Officinalis Gaertn.), the king of arid fruits belongs to family Euphorbiaceae, is popularly known as “Indian gooseberry”, is a small-sized minor subtropical fruit grown widely in North India (Yadav et al., 2017) [12]. India ranks first in the world in the area under cultivation and production of aonla. It is considered to be a “wonder fruit for health” because of its exclusive properties (Kore et al., 2013) [13]. It is one of the important indigenous fruits of the Indian subcontinent, known for its medicinal and therapeutical properties and considered as a wonder fruit for the health-conscious population. It has been grown and known in India for last more than 3500 years. Fruit is Pale yellow, depressed, fleshy, globose, about 2 cm in diameter with 6 obscure vertical furrows enclosing 6 trigonous seeds in 2 seeded 3 crustaceous cocci (Jain et al., 2016) [3]. Aonla fruits are round or oblate, almost sessile, firm, 2-5 cm in diameter 3-celled drupe, indented at the base, and smooth, though 6 to 8 pale lines, extending from the base to the apex, giving it the appearance of being divided into segments or lobes. The endocarp is a slightly hexagonal 3-celled stone containing 6 trigonous small seeds. Seeds are kidney-shaped, shining and reddish brown weighing about 50-70,000 seeds per kg or 1000 psw 15-20 g. Fresh fruits are collected from the trees when the color changes to whitish or greenish yellow. Fruits are collected by spreading a tarpaulin under the tree and shaking the trees or lopping the branches. Ripe fruits are dried until the fleshy covering dries up and hard stones split open to extract the seeds. Alternatively, the fruits are soaked in water for few days to soften the pulp, the pulp is removed by macerating the soaked fruits gently by pounding them in a mortar with a pestle. If the fruits are put in a jute bag the pulp may also decompose faster (two to three days). Stones are separated by rubbing the fruits manually. Seeds are then extracted from the thoroughly washed and dried stones. Seeds are cleaned by a gravity separator or by winnowing. 80-85 kg of fruits yields about 1 kg seed. Germination percentage is low in fresh seeds (4-20%). Dry storage of seeds at ambient condition up to one year with 4-7% moisture content has improved the germination percentage up to 85%; during cold storage, this germination was only reached after more than 4 years.
The seeds can be stored for more than six years if stored at low temperature or below freezing (-20°C to 15°C) even with a wide range of moisture content (4-12%). But seed viability will turn down after two years of storage at the ambient condition at any moisture content (Kundu et al., 2012) [11].

For value addition of aonla into different products variety of machineries and equipments is a prime need. Several equipments and machineries have been developed for manual and automatic processing of aonla fruits. Present review describes detailed information about aonla fruits and seeds and highlights various aonla processing machineries and equipments.

**Aonla processing machines and equipments**

Several equipments and machineries available for different processing operations of aonla like pricking, stone removal, fruit slicing, fruit punching etc. are described as below. Ganachari et al., (2008) [1] designed and developed a hand-operated machine for the removal of seed from the fresh aonla fruit. The machine consisted of fruit seat, fruit punching rod, handle and frame to hold all the parts. The machine had a capacity of 16.66 kg per h or 530 fruits per h. The pulp and juice wastage was recorded to be 10 percent. The cost of the machine calculated was ₹ 650, in which only the seat and the punching rod were made of stainless steel and all others parts were of mild steel. The cost of operation, including the labor cost and depreciation, was ₹ 10.20 per h.

Swarnakar et al. (2018) [10] developed manually operated aonla stone removing cum slicing equipment as shown in Plate (1). Its capacity is 12 to 14 kg/h. The components of the cutting tool are connecting bolt, solid cylinder, penetrating rod, and cutting blade. Experimental setup of the manually aonla stone removing cum pulp slicing equipment consist of aonla resting seat cutting tool, push the lever, stand and a stone collecting unit. The average pulp loss was estimated at about 10.05%. The pulp recovery was found 89.89%.

**Plate 1: Manually operated aonla stone removing cum slicing equipment**

Nambi et al., (2012) [6] developed pneumatic assisted electronically controlled continuous aonla seed removing machine (Plate 2) which consists of a fruit platform, a punching plunger, a punching driving mechanism, a conveying system, and an electronic control unit. The machine was evaluated with three different Plungers viz. sharp edge, hollow cutting edge, and star cutting edge in a different orientation of fruit with three varieties of aonla with variably sized fruits. The study indicated that the effectiveness of the machine and the percentage of fruit pulp wastage varied with the size of the fruit. The highest efficiency of the machine was observed as 93.94±0.42% with the combination of the apex end punching with hollow edge plunger in set A for NA-7a whereas Kanchan, Chakiya and NA-7b recorded higher effectiveness of 94.47±1.22%, 95.15±0.33%, and 94.14±0.49% respectively in set B. The percentage pulp wastage was 4.05±0.96%, 3.22±0.20%, 3.59±0.43% and 3.93±0.12% for Kanchan, Chakiya, NA-7a and NA-7b, respectively. The percentage juice wastage for Kanchan, Chakiya, NA-7a, and NA-7b was 1.48±0.25%, 1.63±0.15%, 2.47±0.32%, and 1.92±0.61%, respectively. The evaluation study concluded that apex end punching with 12 mm hollow cutting edge plunger with 15 mm bore platform would be suitable for the deseeding of aonla fruits having less than 35 mm size, while for the fruits having more than 35 mm size, plunger of 15 mm diameter with 18 mm bore platform would be suitable. The capacity of the developed machine was 90 kg/h or 3000 fruits/h. The cost of operation including the labor cost and depreciation was calculated to be ₹ 0.14 per kg of fruits.

**Plate 2: Pneumatic assisted electronically controlled continuous aonla seed removing machine**

Salwe et al., (2012) [10] developed an amla punching machine. The machine consisted of following parts viz. Frame, hopper, cylindrical drum, Punching needle, bearings, flat belt, pulleys, amla removal tool, safety guard and collector. In this machine, the cylindrical needle platform punches the amlas on its whole circumference. A single amla is punched more than ten times on its whole surface. The depth of the punches is 10-15 mm. After getting punched, the amlas are discharged from the machine and can be connected to plastic cranes. The machine is complete with electric motor, starter, etc. Amla punching machine is a simple machine which is used for punching the amla in a proper way to prepare murabba.

Kumar (2014) [5] ergonomically developed foot operated aonla pricking machine as shown in Plate (3) and evaluated its performance. Optimization of a number of process variables namely speed of the machine (35, 45 and 55 RPM), duration of pricking activity (30, 40 and 50 min) and seat height (836, 928 and 1020 mm) were attempted using response surface methodology. The machine had a capacity of pricking 27 kg of aonlas per hour at 55 RPM with no damage to the fruits and with proper number and depth of pricks. During the
pricking of aonlas, the juice which got squeezed out of the fruits was also collected with the help of a juice collector provided in the machine itself. On an average, 39 ml of juice was collected per kg of the aonla pricked. The economic analysis revealed 2 years of payback period and 67.4% as breakeven point.

Shaik (2014) [7] worked on the development of multi-seated aonla seed removing and segmenting machine (Plate 4), based on physical properties of aonla varieties namely, Chakaiya and NA-7. The machine consisted of the mainframe, circular platform with fruit rests (6 Nos.), plungers (6 Nos.) with cutting blades, plunger reciprocating mechanism, worm and worm gear, belt drive and 1hp motor. The machine was operated at 9 rpm speed of worm gear with 14 mm diameter plunger. The machine has deseeding cum segmenting efficiency of 91.1 and 88.8% for Chakaiya and NA-7, respectively with an effective capacity of about 84 kg/h for Chakaiya and 67.5 kg/h for NA-7 cultivar, and 2700 fruits/h for both the cultivars. The pulping efficiency, percent fruit pulp wastage, fruit juice wasted and percent whole segmented fruit recovery were found as 86.1%, 7.7%, 6.0% and 84.4% for Chakaiya cultivar and 85.3%, 8.7%, 5.9% and 80.0% for NA-7 cultivar. The operating cost of the machine per kg is Rs.0.38/- or Rs. 377.9/tonne. The cost of operation of the machine for cutting 16.6 kg is ₹ 6.25/- as compared to hand operated machine developed by earlier researchers was ₹ 10.20/- for the same production. The saving in cost was 38.7%.

Ganvir and Awate (2015) [8] worked on the design of aonla fruit seed removal and shredding machine. It consisted of a hopper, a pneumatic punching machine, a conveying system, and an electronic control unit in a master frame. A moving circular conveyor disc with holes at the equal distances designed to convey the fruit to the deseeding position where the fruit platform was fixed at the disc which also has a center hole. Above the fruit platform, a pneumatic punching machine with some extra power was fixed concentrically. The seed removing operation was carried out by a pneumatic type controller which moves the punching plunger up and down with the help of compressed air. At every punch seed was removed and collected in the seed collecting tray. Then the deseeded fruit was conveyed to the discharge end. The effectiveness of the machine and fruit pulp wastage varied with the size of the fruit.

Ghuge et al., (2016) [9] designed an amla punching machine as shown in Plate (5) to prepare the murraba and pickle. On the basis of design and analysis by ANSYS software, they conclude that the stresses occurred on the machine are under control. Hence this machine is safe with respect of operators and environment.

Kapdi et al. (2000) [4] developed a continuous flow, power operated machine for the production of aonla shreds as well as extraction of stone. The machine consists of a hopper, a tapered roller, a drum chamber with concave sieve, a discharge chute and a power transmission system. The machine was tested at roller speed ranging from 200 to 400 rpm. At 330 rpm speed of roller, maximum aonla shreds (97-98%) were recovered with minimal breakage of stone (6-7%). The capacity of the machine is 60-70 kg/h, which is 10 times more than the manual processing. The cost of processing of aonla using the developed machine is just ₹ 159 per tonne as compared to Rs. 833 per tonne for manual extraction.

**Conclusion**

Aonla has exclusive chemical composition and health benefits. Due to its sour test most people find it intolerable, and hence is favored in the form value added products. Aonla processing methods arises need of equipments and machineries. The modern machineries and equipments mentioned in the article for preparation of different aonla
products are hygienic, consume lesser time and provide maximum retention of nutrients. Development of newer technologies is need of hour to mechanize processing operations to produce quality products of aonla for domestic as well as global market and to generate employment through its processing. Aonla has great potential for processing it into a variety of value-added products with great demand nationwide as well as the worldwide market.

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References