DEVELOPMENT AND TESTING OF A POWER OPERATED ASHGOURD SEED EXTRACTOR

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INTRODUCTION

Our country has achieved self-sufficiency and good degree of stability of food production. This created an urgent need for providing health security to our population by supplying nutrition through balanced diet. Vegetables form the most important component of balance diet. India is the second largest producer of vegetables in the world next to China with an estimated production of about 96.49 million tonnes from an area of 6.9 million hectare (Anon, 2002). India shares about 12 % of the world output of vegetables, from about 2.0 % of cropped area in the country.

The per capita consumption of vegetables in India is only about 140gm, which is far below the minimum dietary requirement of 280 gm/day/person. The demand of vegetables has been increasing fast in the urban areas with a gradual rise in standard of living coupled with development of communication and transport facilities. It therefore calls for a major research and development effort to achieve the target.

The cucurbitaceous crops or cucurbits play a vital role in the supply of fresh vegetables and to certain extent as fresh fruits during summer in the plains of India. They all belong to the same family but different genera. These crops constitute the largest group of vegetables and India has been leading in the origin and introduction of a number of cultivated cucurbit species.

Ashgourd [*Benincasa hispida (*Thumb.) Cogn], occupies a prominent position among the tropical cucurbitaceous vegetables cultivated in Kerala. Its synonyms are hairy melon, winter melon, ash pumpkin, white pumpkin, Chinese preserving melon, waxgourd and white gourd. The origin of ashgourd is believed to be Java and Japan, where it is found growing wild. Ashgourd is a robust, hispid monoceous annual vine with stout prominently furrowed stems and bifid tendrils. (Nayar and More, 1998)

The fruit of the ashgourd is cooked as a vegetable and when ripe, it is used for preparing the sweet delicacy – petha. The fruit also finds use as laxative, diuretic, anti-pyretic and in naturopathy treatment. The ayurvedic nerval tonic 'kushmandarasayanam' is prepared from the immature fruits of small type of ashgourd. An enzyme extracted from ashgourd juice has been successfully used instead of calf rennet in the production of cheddar cheese. Seeds could be a potent source of vegetable oil and protein. There is a great potential for the crop to be used as a nutritious cattle feed.

Seed is one of the important input, which contribute to 30 % of the total production potential of any crop. Seed production and trade have not developed in the country on any scientific lines and that the approach is not systematic. In view of farmer’s growing awareness about the use of quality seeds mechanization will approve to be an effective solution.

In India, manual method of seed extraction is mostly followed for vegetables. Even though manual methods procure more seed yield per unit area, the method is quite cumbersome, unhygienic and monotonous. Moreover, the cost of seed extraction from wet vegetables like ashgourd also add to the total cost of seed production. Manual seed extraction process is quite slow, thus keeping the seeds exposed to weather for a longer period. Also the vegetable seed farmer does not find adequate labourers to get the seed extracted within the shortest possible time at disposal. On the other hand, mechanical seed extraction reduces cost of production and increases the rate of seed extraction. Many seed extraction machines have been developed in various parts of country for vegetables namely chilli, tomato, cucumber, watermelon etc. these extractors involved crushing of the pulp which is then wasted without any use, which is not affordable in case of ashgourd, as the flesh can be utilized for more useful products. Thus a seed extractor in which flesh is not mashed is much more economical.

Keeping this in view, the study was undertaken with the following objectives

a) To study the physical properties of ashgourd fruit relevant for fabrication.
b) To fabricate a power operated seed extractor for ashgourd.
c) To evaluate its performance
d) To compare the germination capacity of the extracted seeds by manual methods and those obtained from the seed extractor.

REVIEW OF LITERATURE

This chapter deals with the constituents, varieties and different methods adopted by various research workers for the extraction of vegetable seeds.

Agronomical characteristics of Ashgourd

Ashgourd is an annual hispid (rough with bristle like hairs) climbing, herbaceous, monoceous plant varying several metres in length. The leaves are broad with 5-11 angular lobes. The staminate flowers have only peduncles, the pistillate flowers have densely haired ovaries on short peduncles. The corolla has five large petals yellow in colour.

Ashgourd is generally grown on small scale all over India for its fleshy fruits. The plants prefer a warm climate, and do well in plains and hills of low elevation. The main crop of the ashgourd is grown from the beginning of June to the end of July, but an early crop can also be produced by sowing the seed from February to March. It does well in a light sandy soil. It requires perfect drainage and is susceptible to water logging.

The fruits are broadly cylindrical or spheroid in shape, 25 to 40cm long, 15to 25cm in diameter. The flesh is white and fruit contains numerous compressed and marginal seeds. The surface of the fruit is covered with bluish white, ‘waxy ash’. It can be stored longer than any other cucurbits. (Nayar and More, 1998)

2.2 Origin

The origin of ashgourd is believed to be Java and Japan, where it is found growing wild. It’s cultivation in China dates from remotest antiquity. Chinese scriptures of A.D V and Vl refer to ash gourd. It is generally cultivated in most of the tropical countries and in many parts of India for its fruit

2.3 Varieties

The ashgourd group is prominent with three cultivars:

i. Fruits nearly round and essentially hairless

ii. Fruits nearly round and hairy

iii. Fruits oblong and hairy. (Peter *et al*.1991)

Some of the improved varities of ashgourd are listed below:

Indu - Thick flesh (5.27 cm), larger fruit, 4 to 8 kg, yield 25 t/ha

KAU-local- Oval shape, large fruit, 6 to 7.5 kg, duration 110-120 days, yield 32 t/ha

Co-1 Medium early variety, fruits globular bigger in size (5to 6 kg) with less seeds and more flesh, crop duration 140 days

Co-2 An early maturing variety, fruit is small sized (length 40 to 50 cm, diameter 20 to 30 cm), weight not more than 3 kg.

2.4 Harvesting

The fruit intended for storage should be harvested after it is fully ripe. The young fruit is somewhat hairy, but becomes smooth and covered with a bluish white waxbloom when ripe .On ripening, the peduncle withers dry and the fruit becomes somewhat light as the water content is reduced. (Yawalkar, 1985)

2.5 Major constituents

The major constituent of ashgourd is water and other constituents with their composition in 100 gm edible ash gourd fruit is presented in Table 2.1

Table 2.1 Composition of ashgourd

Major constituents	Composition
Edible portion	67 %
Moisture	96.5 g
Fibre	0.8 g
Protein	0.4 g
Fat	0.1 g
Carbhohydrate	1.9 g

Ashgourd contains Vitamin A and is also a good source of Vitamin B and C. It has got an energy value of 10 Kcal / 100 g. It is considered to be of great medicinal value.

Seed Extraction

2.6.1 Manual methods of seed extraction

Ritchie (1971) described the various methods for tomato seed extraction. In fermentation method, seeds and pulp were squeezed from the fruit and left for fermentation for 5-6 days in a warm room. During this, the mucilage was broken and clean seeds were obtained after repeated washing. In other methods, using sodium carbonate the seed pulp was mixed with equal volume of 10 percent of chemical and left for 18-24 hours and then washed. In HCl method, 567 ml of conc. HCl was added to 10 kg of fruit, stirred well and washed after 30 min. A combination of 4 percent HCl and 0.6 percent pectinase enzyme was added in equal volume to the slurry where in the mixture was allowed to stand for 24 hours and then washed.

Jacqueline (1984) described the methods of seed extraction of brinjal. The fruits were beated with wooden rollers and the seeds were dried after washing. In another method, the fruits were pulped and allowed to stand overnight in a solution of 30 g of cut fruits. The mixture of seed and pulp was treated with 30 ml of conc. HCl per kg of pulp and stirred constantly. After 20 min, the pulp was washed and the seeds were separated. Cut fruits were soaked in equal quantity of water and allowed to ferment for 3 days. Then the fruits were squeezed and seeds were separated. A pulper was also used. For 1 kg of water 250 ml of water added. The mixture of pulp and seed was washed with water to separate the pulp and skin.

Raymond (1985) reported wet and dry method of seed extraction from brinjal. In wet extraction, the fruit were first crushed and then passed though a screen to separate out the gelatinous seed from the bulk of the remaining material. Extra water was added during and after crushing in order to improve separation of seeds. In the dry seed extraction, the over ripe fruits were dried in the sun untill they shrivelled. The drying was accompanied by fading of the skin colour to a coppery brown colour. The fruits were then hand beaten and then dried seeds were hand extracted.

Agong (1993) reported that conc. HCl extraction procedure for brinjal, gave the highest germination percentage (92 %) on freshly extracted seeds followed by fermentation method (88 %). Ten percent sodium carbonate gave mean germination rate of 85% percent. The method of extraction influenced the extent of seed viability with time. The traditional method offered good seed viability after eight months of storage. It was also reported that the use of conc. HCl was appropriated where seeds are extracted for immediate use.

2.6.2 Mechanical methods of seed extraction

Nicholas (1971) developed a mechanical vegetable seed-extracting machine. Its main parts were a horizontal drum with a rotary shaft and beaters. The drum was made of GI sheet. The rotary shaft with beater rotates inside the drum. The beater had a bend MS flat holder welded to the shaft and was spirally arranged on the shaft. To this holder a replaceable blunt was bolted. A screen holding frame was fitted at the bottom section of the frame to allow the fitting of different screens. Two outlets were provided one at the bottom of the drum to collect the extracted seeds and juice, coming out of the screen. The second outlet was provided at the rear end to remove the pulp. A pipe for water was also attached to the top of the drum. Dry feeding of brinjal resulted in 75 percent seed extraction efficiency. The efficiency was 10 kg of seed per hour and 93 percent germination was obtained.

Reed (1981) developed a pressure spray system, which eliminated fermentation process for cleaning the muskmelon seeds .The holes of about 3mm diameter were cut in the edge of fruit. Seeds were flushed out with a stream of water from a tap. The fruit was held over a kitchen strainer with blossom end of the fruit suspended inside the strainer. The water from the tap was fed into the stem- end hole and water poured into the seed cavity. Seeds flushed out of the fruit were collected in the strainer. The fruit was then inverted and the process repeated until all seeds were removed. This system could be used for extracting seeds from a limited number of fruits.

Wehner *et al.* (1983) constructed a plot scale extractor for cucumber seeds. The machine can extract seeds form matured cucumber fruit at the rate of about 100 fruits per minute. It recovered 98% of seeds that could be extracted by hand. The machine consists of two counter revolving fruit crushing rollers, a rotating drum for separating the seeds from the pulp and flesh, an inter connecting gravity transfer chute and a seed collecting pan.

Kachru *et al.* (1996) reported that a rotary cylinder with corrugation on its surface could be used as seed extractor for tomato. This unit is rotated manually inside a stationery expanded metal concave supported on a holding frame and provided with a feed hopper. The clearance between the cylinder and concave supported was varied from maximum 90 mm at the top feeding end to a minimum of 15 mm at the discharge end. The speed of the cylinder was maintained at 40-45 rpm by a handle mounted on the drum shaft. During operation, tomatoes were crushed between the corrugated cylinder and the concave metal due to shear. Auger was provided on rotary cylinder to carry the pulp and the skin while the juice and seeds were collected at the bottom of the cylinder. The juice and seeds were allowed to ferment for 24 hours to remove the gelatinous coat from seeds. The seeds were then separated, washed, cleaned and dried.

Verma *et al*. (1992) designed an axial flow vegetable seed-extracting machine. The main component of machine is a cylindrical casing, a feeding chute, a primary cutting chamber, axially mounted cutting knives and rakes, water sprinkling system regulating gates and seed and pulp outlets. Ripe fruits were fed into the primary chamber and sliced into small pieces by rotating blades. Ripe fruits were further crushed in the crushing chamber. Separation of seeds from pulp was accomplished by the water escape through the concave and ripe fruits of seven common Indian vegetables and its performance was compared to that of manual seed extraction. The axial flow vegetable seed-extracting machine is suitable for the wet seed extraction of most of the Indian vegetables. The percent seed loss was found out using the formula

$$\text{Percent seed loss} = \frac{S_2}{S_1 + S_2}$$

where,

S_1 = Weight of seeds collected form seed outlet (kg)

S_2 = Weight of seeds passing through the pulp outlet (kg)

Gabani and Siripurapu (1993) developed a chilly seed extractor. The machine was operated by a1440 rpm electric motor .A hopper fitted on the top of the crushing assembly encompassed a concave and star roller fitted on a shaft .A drum separator assembly, consisting of a screen and flight fitted on a shaft attached below. Here, the chilliies were crushed further and the screen separates the seeds from the crushed material. A collecting pan was fitted below to collect the seeds. The mixtures of seed and small skin particles were fed to cleaning unit and cleaned seeds were collected at the seed outlet.

Devdas *et al.* (1993) fabricated a horizontal type tomato seed extractor. It consisted of a feed hopper, a beater assembly and a centrifugal basket. The beater assembly and centrifugal basket were coupled with a 1.5 hp motor. The outer basket meant for collection of pulp material was fixed to a frame. The operation was done in batches and extraction of seeds was carried out with the necessity of fermenting the pulp. The rotor was rotated at speed of 1440 rpm. Extraction of the seeds was found to be 85 percent. The capacity of this tomato seed extractor was 60 kg of fruits per hour. Cost of extraction was Rs. 7/ kg of seed.

Deepthi *et.al*. (1993) fabricated and tested a power operated axial flow seed extractor. The efficiency of the machine was evaluated for tomato and cucumber and compared with the manual seed extraction. The main components of the machine were a feed chute to induct the material into cutting chamber. The chamber consisted of blades for primary, sweeping and fine crushing together with rakes mounted on a rotor shaft. The seeds were extracted through concave screen. A semicircular cover was provided over the entire length of crushing chamber. On the top of cover, a water-spraying boom was provided in order to remove the seeds from the inner surface of concave and seed collecting chamber. Power requirement of the machine was 2 hp, which consumed an additional power of 0.5 hp for sprinkling of water. The rate of seed extraction for the tested vegetables was 40.97 kg / h and 6.56 kg / h for tomato and cucumber respectively. Percent seed losses were 4.3 and 4.91 for tomato and cucumber, respectively. Tomato seeds showed a germination of 86 percent in mechanical process. In cucumber, theses were 100 and 78 percent.

Wehner and Humphires (1995) developed a single fruit extractor for cucumber to increase the speed and ease of seed removal from individual, mature cucumbers for later drying and planting. The machine comprised of an extractor cone for excavating the seed cavity and a means to drive it, a pail or containment vessel to collect the seeds and a strainer. The machine saved about 47 s per fruit compared with manual method and was suited for handling single fruits by researchers requiring seeds controlled pollination.

Mohanty *et al*. (1997) designed and developed a vegetable seed-extracting machine. The cost of fabrication of the machine was Rs.3000. The machine consisted of fixed cylindrical casing with a sieve and rotating shaft with cutting, crushing and conveying blades. Water was sprinkled during seed extraction. The test result of this machine using 0.5 hp showed that the capacity was 210.96 kg/h for tomato at 370 rpm with an average seed extraction efficiency of 84.7 percent. The percent of seed germination was 82.2% without a visible damage to seeds. Cost of seed extraction was Rs. 8.64 per quintal.

Kingsly (1998) fabricated a brinjal seed extractor. The extractor consisted of a fruit crushing chamber and seed separation unit. In the crushing chamber the brinjal fruits were crushed into pulp by the crushing rods. The pulped brinjal fruit was fed into the seed separation unit and continuously agitated at a constant agitator shaft rotating at 35 rpm. Due to the difference in specific weight, the pulp floats in water and gets separated in the pulp outlet, whereas seeds in the water and passes through a sieve kept at the bottom of the drum and gets selected in the seed outlet. The cost of the unit was worked out to be Rs 14,350 and the cost of the seed extraction were found to be Rs 990 per kg compared to Rs 89.20 per kg in case of manual extraction.

Praveen (1999) developed a tomato seed extractor, which consisted of two main components namely fruit squeezing chamber and seed separation unit. The tomatoes were fed through a tray type horizontal shaped feed hopper provided at an angle 23° to horizontal. The tomatoes were squeezed in the squeezing chamber by a screw auger. Studs were used for more efficient separation of seeds from squeezed fruits. In the seed separation unit due to continuous water spray and the rotation of studs, the seeds were separated from the flush and collected along with the juice through the perforated cylinder in a vessel. The seeds being heavier than the juice settles down and then collected by draining the juice. The seeds were then treated with 25% HCL for 30 min to remove gelatinous coating and other pulpy material. The treated seeds were then washed separately to get cleaned seeds.

2.6.3 Other studies

Kannath (1996) studied the effect of fruit maturity, seed processing and storage methods on seed quality of ashgourd. It was found that seeds extracted by machine extraction + acid treatment at the rate of 1% HCl of the pulp for 30 minutes recorded the highest overall germination percentage (89 %). There was a considerable increase in germination of seeds, when fruits were stored for three months at moisture content of 8.2 %. Seeds from the fruits stored after three months also recorded the highest speed of germination. Among the different packing materials packing in polyethene bags of 700 gauge was found to be best. Effect of seed treatment also had a significant effect on germination except in two months. Among the different seed treatments, captan was found to be superior and recorded highest overall mean germination percentage

2.7 Methods of germination

The following are the different methods by which germination of seed is being tested by seed technologists in India.

2.7.1 Method using paper

2.7.1.1 Top of paper

The seeds are germinated on top of one or more layers of paper that are placed in any of the following ways: -

a) Enclosed in transparent petridishes or boxes - The appropriate quantity of water is added at the beginning of the test. Evaporation may be minimized by a tight fitting lid or by enclosing the dishes in plastic bags.

b) Directly on germination trays in cabinet or room type germinate - In this method, the relative humidity in the germinator or room must be maintained as close as possible to saturation. Moistened porous paper or absorbent cotton can be used as base for the paper, or even as an immediate substratum.

2.7.1.2 Between paper

The seeds are germinated between two layers of germination paper either by loosely covering the seeds with an additional layer of germination paper or by placing the seeds in to folded envelopes, which may be placed in a flat or upright position or by placing the seeds in rolled towels. The rolls should be placed in an upright position in the following ways:

a) Directly on germination trays in cabinet or room type germinates

b) In metals, plastic or glass boxes

2.7.2 Methods using sand

The method using sand is of much practical utility because the conditions here are quite comparable to that of the field. It can be done in following two ways:

2.7.2.1 S (in sand)

Seeds are planted in a uniform layer of moist sand and then covered to a depth of one to two cm with sand, which is left loose.

2.7.2.2 TS (top of sand)

Seeds are pressed into the surface of the sand.

The amount of water to be added to the sand will depend upon its characteristics and size at the seeds to be tested. The optimum amount should be determined for the given seed, so that a measured quantity could always be used in routine testing.

2.7.3 Germination method using soil

Soil or artificial compost may be used instead of sand, although it is generally more difficult to standardize and is therefore, liable to cause greater variation between results. It is for this reason that soil is never recommended as primary testing substrate. But this substratum must be used to confirm the evaluation of seedlings in doubtful cases, and for testing samples, which produce seedlings with phytotoxic symptoms when germinated on paper or sand. (Agrawal, 1980)

MATERIALS AND METHODS

Details of the methods adopted in the determination of physical properties of ash gourd fruit relevant to seed extraction are discussed in the chapter. The development of ash gourd seed extractor and methodology used for germination studies are also discussed in detail.

3.1 Test sample

Ashgourd, KAU local variety procured from the instructional farm of KCAET, Tavanur was used for the study.

3.2 Physical characteristics of fruit

The physical properties of ashgourd fruit like length, diameter and number of seeds were determined for initial studies.

3.2.1 Length

The fruit was cut longitudinally into two equal halves and length of fruits excluding the stalk was measured from base to the tip and expressed in mm.

3.2.2 Diameter

Breadth of fruit at the middle of the longitudinal halves was measured as diameter and expressed in mm.

3.2.3 Number of seeds

Seeds from the fruits were separated and counted and number of well-filled seeds were recorded.

3.2.4 Moisture Content of seeds

Moisture content was determined using oven method. In this method, the working sample 4 to 5 g must be evenly distributed of the surface of the container. Weigh the container and its cover before and after filling. Place the container rapidly on the top of its cover, in an oven maintained at a temperature 130° - 133 °C for one hour.

The moisture content as a percentage of weight should be calculated by means of the following formula. (Agrawal, 1980)

$$\text{Moisture content (\%)} = \frac{M_2 - M_3}{M_2 - M_1} \times 100 \quad \text{....3.1}$$

Where, M_1 = weight of the container and its cover (g)

M_2 = weight of the container, cover and its contents before drying (g)

M_3 = weight of the container, cover and its contents after drying (g)

3.3 Development of ashgourd seed extractor

The constructional details of power operated ashgourd seed extracting machine are given in Appendix 1. It consists of following parts:

1) Main frame
2) Feeding V – groove
3) Outer cover
4) Flexible shaft
5) Cutting blades
6) Seed outlet
7) Seed collecting drum
8) Power transmission system

3.3.1 Main frame

Angle iron of MS of size 30 x 30 x 5 mm was used for fabricating the main frame. It has a rectangular shape. The cross section of the frame at the top is a square of size 600 mm and height is 900 mm. The frame was well braced to provide rigidity to mount and support other parts of the machine and to withstand the vibration during the operation.

3.3.2 Feeding V- groove

A V- groove was provided in the main frame to hold the ashgourd in place. The dimensions of V-cut was decided by considering the mean length and diameter of ashgourd. The V-shape is chosen to avoid slippage and to handle different size of ashgourd. The depth, top width and length of the V- groove are 150 mm, 250 mm and 250 mm respectively. The angle of V-cut is 80°.

3.3.3 Outer cover

GI sheet (22 gauge) was used to cover the top of the frame. The sheet was cut to a square section of size 100 cm. Out of which 20 cm was bent and joined with MS flats kept at the four sides of the frame by nuts and bolts. This was done to facilitate riveting and thus increase its structural strength. Over the V- groove, a wooden block was kept to provide a slanting seat for the ashgourd and hence to have a free flow of the seeds to the outlet.

3.3.4 Flexible shaft

The flexible shaft is the main component of the ashgourd seed extractor. The total length and inner diameter of the shaft is 1500 mm and 5.5 mm respectively. It is given a nylon coating. The rpm of the flexible shaft was fixed to 240 rpm based on preliminary studies. One end is connected to the rotor shaft coupled with the pulley and the other end is connected to the cutting blades. The flexible shaft has got the unique characteristics to extend to required length and diameter of fruits by moving it with the hand. (Plate 1 and Fig 3.1).

3.3.5 Cutting blades

The cutting blades were made out of 2 mm GI sheet and electroplated. Two circular sheets of 65 mm diameter were cut, splitted midway and bent to get a circular slotted type blade. The diameter of the blade was fixed on the basis of the core diameter of the fruit. On the periphery of each blade 10 teeth were cut. The teeth are 6mm wide and 10 mm deep. The cutting blades were then connected to 12 mm MS rod. (Fig 3.2)

3.3.6 Seed outlet

A V-channel made of 22 gauge GI sheet was attached to the V-groove to discharge the seeds along with the pulp to the collecting drum placed at the bottom of the extracting machine.

3.3.7 Seed collecting drum

The extracted seeds along with the pulp coming out were collected at the bottom of the drum. As soon as the drum was filled it was kept in an undisturbed condition for 5 minutes. During this time, matured seeds being heavier settled at the bottom and were collected for germination studies.

3.3.8 Power transmission system

The power transmission system consisted of 0.5 hp single-phase electric motor, rotor shaft and pulleys. A V- belt and pulley system transmitted the power to the flexible shaft. A pulley of 50 mm diameter was connected to the motor and the drive was transmitted to the rotor shaft. To reduce the speed to 240 rpm, the rotor shaft was connected to 300 mm diameter pulley. The rotor shaft then transmits the power to the flexible shaft attached to it. (Plate 2).

3.4 Testing procedure

After fabrication of the machine, the testing of the machine was carried out to evaluate the performance of the machine. The performance of the machine was compared with the existing method of manual extraction of ashgourd seeds.

3.4.1 Mechanical method of extraction of ashgourd seeds.

The extraction of ashgourd seeds involved cutting of the top portion of the fruit and placing the ashgourd in V-groove. The flexible shaft is then moved inside the fruit .As result seeds were extracted and discharged through the seed outlet. The extracted seeds were then collected in the water filled drum. After 5 minutes, the matured seeds being heavier than pulp settles down and was then collected. Testing of the unit was carried out at 240 rpm.

3.4.2 Manual method of ashgourd seed extraction

The fruits were longitudinally cut and the seeds were scooped out. The extracted seeds were cleaned and separated by repeated water washings. Two labourers were required for the manual extraction of seeds.

3.5 Performance evaluation

After the fabrication of the ashgourd seed extractor, its performance was tested by determining the various parameters.

1. Capacity of the ashgourd seed extractor
2. Rate of seed extraction
3. Seed extraction efficiency
4. Energy requirement
5. Percentage of seeds germinated in each lot which were subjected to germination test
6. Speed of germination
7. Root length of the seedlings
8. Shoot length of the seedlings
9. Vigour index of the seedlings

3.5.1 Determination of capacity of machine

Capacity is defined as the total weight of ashgourd from which seeds were extracted per unit time.

$$\text{Capacity (kg/h)} = \frac{\text{Total weight of ashgourd processed (kg)}}{\text{Time taken for extraction (h)}} \quad \ldots 3.2$$

The ashgourd were weighed .The time for cutting and extraction were recorded separately. These were used in the determination of capacity of the machine.

3.5.2 Determination of seed extraction efficiency

The seed extraction efficiency was calculated from the formula;

$$\text{Seed extraction efficiency, \%} = \frac{S_1}{S_1 + S_2} \quad \ldots 3.3$$

where,

S_1 = weight of the seeds collected from seed outlet (g)

S_2 = weight of the seeds remaining in the fruit after extraction (g)

3.5.3 **Rate of seed extraction**

Rate of seed extraction was determined by weighing the amount of the seeds extracted and the time of extraction. It can be calculated as:

$$\text{Rate of seed extraction} = \frac{\text{Weight of the seeds extracted (kg)}}{\text{Total time taken for extraction (h)}} \quad \ldots 3.4$$

3.5.4 Energy requirement

Energy required at no load and loaded conditions were determined using an energy meter. The energy meter was connected in series with the motor by running the unit without load and with load and readings were noted and recorded.

3.5.5 Seed germination

According to the International rules for seed testing, sand method of germination was followed for ashgourd seeds. Representative samples from extracted seed lots were taken for the germination studies. Samples were also taken from the seeds extracted by manual methods. In this method, aluminium pans were taken as containers and fine river sand was used, after washing as germination medium. About 75 ml of water was poured in for 500g of sand and two were mixed well. The pans were filled with moistened sand to three fourth of their depth. The seeds were placed on the surface of sand and were then covered with a thin layer of sand. The thickness of the sand cover was about 10-20 mm. The pans were sprinkled with water as when they need. The seedlings were evaluated on the tenth day of the emergence of the first seedling (final count day) and total numbers of normal seedlings were recorded. The mean number of normal seedlings emerged to the total number of seed sown was expressed as germination percentage.

3.5.6 Speed of germination

From the samples sown for recording germination, number of seedling emerged was recorded daily until the tenth day of the emergence of first seedling. Cotyledons slipping out of the seed coat were taken as the criteria for germination of normal seedling. From the mean germination percentage recorded on each counting date, speed of germination was calculated employing the following formula suggested by Maguire (1962).

$$\text{Speed of germination} = \frac{X_1}{Y_1} + \frac{X_2 - X_1}{Y_2} + \ldots + \frac{X_n - X_{n-1}}{Y_n} \qquad \ldots 3.5$$

where ,

X_n = percent germination on nth day

Y_n = number of days from sowing to nth count

3.5.7 Root length of seedlings

At the end of the germination test period i.e. on the final count day, five normal seedlings were carefully uprooted at random from the test sample and measured the root length and computed the mean. The length between collar and the tip of the root was measured as root length and expressed in cm.

3.5.8 Shoot length of seedlings

From the sample after measuring the root length, the length between collar and tip of the leaf was measured in cm and the mean value was recorded as shoot length.

3.5.9 Vigour index of the seedling

Vigour index predicts the stand – producing potential of seed lots.Vigour index was computed adapting the following formula and expressed as whole number. (Abdul- Baki and Anderson ,1970)

Vigour Index = germination percentage x mean length of root and shoot in cm …3.6

3.6 Comparison of the seed and seedling characters obtained by manual and mechanical methods

A sample of ashgourd was taken and it was cut into two equal halves. One half was manually extracted and other was subjected to mechanical extraction. The extracted seeds were dried in shade for one day and then in sun avoiding peak hours. Significant seed and seedling characters were studied and compared for both the methods.

RESULTS AND DISCUSSION

This chapter deals with the result of experiments on the physical properties of the ashgourd fruit. Also the performance of the newly developed power operated seed extractor is discussed.

4.1 Physical properties of fruit

Ten ashgourd samples were studied to find the mean length, diameter, number of seeds and moisture content of the seed. The results are given in Table 4.1

Table 4.1 Physical properties of ashgourd

.	Physical properties	Average values
A .Ashgourd fruit	1. Size a. Length b. Diameter 2.Moisture content of fresh seeds	 273 mm 234 mm 57.2 %

The average value of length and diameter of ashgourd fruit were found to be 273 mm and 234 mm respectively. In order to design the V-groove higher value of 300 mm and 250 mm as length and diameter was selected.

4.2 Performance Evaluation of power operated ashgourd seed extractor

The performance of newly developed extractor was evaluated and results were discussed below.

4.2.1 Capacity of the ashgourd seed extractor

From the equation explained in 3.6, the average capacity of the machine was found to be 81.39 kg / h. The results are shown in Table 4.2

Table 4.2 Capacity of the machine

Sl No.	Wt. of ashgourd (kg)	Time taken for extraction (s)	Capacity (kg / h)
1.	6.9	330	75.27
2.	9.0	358	90.50
3.	7.6	378	72.38
4.	10.2	420	87.40
		Average	81.39kg/h

It was observed that capacity of the machine depends upon the stage of maturity, variety of ashgourd and also the skill of the operator in moving the flexible shaft along with the blade. The seed extraction was done at the speed of 240 rpm, which was chosen as optimum speed based on preliminary studies. Though further increase in rpm may result in slight increase of the capacity but it may affect the quality of the seeds.

4.2.2 Rate of seed extraction

The rate of seed extraction by the newly developed seed extractor was determined and presented in Table 4.3.

Table 4.3 Rate of seed extraction

Sample size (kg)	Total time taken (s)	Wt. of seed recovered (g)	Rate of seed extraction (kg /h)
6.9	330	189.8	2.070
9.0	358	132.8	1.335
7.6	379	212.6	2.025
10.2	420	262.5	2.252

It was revealed from the experiment that the rate of seed extraction depends on variety, maturity and also the skill of the operator. A fruit having a good placentation of seed may increase the rate of seed extraction.

4.2.3 Seed extraction efficiency

The extraction efficiency of the machine was calculated from the equation 3.3. Average extraction efficiency of the developed seed extractor was found to be 97.5 %. (Table 4.4)

Table 4.4 Seed extraction efficiency

Sample (kg)	S_1 (g)	S_2 (g)	$\frac{S_1}{S_1 + S_2}$ (%)
6.9	189.8	4.0	97.40
9.0	132.8	3.8	97.20
7.6	212.6	5.1	97.60
10.2	262.5	5.2	98.05
		Average	97.5 %

It was observed that the extraction efficiency depends on the movement of the flexible shaft, size and shape of the blade and also the fruit characters. Extraction efficiency can be increased by size reduction of fruit. But it may decrease the capacity of the machine. Besides, the skill of the operator in uniformly extracting the seeds with the flexible shaft is also an important factor in determining the extraction efficiency. This is achieved through the experience of the operator.

4.2.4 Energy requirement in no load and loaded condition

Energy required for operating the machine under no load condition at 240 rpm was determined. The average energy requirement under no load and loaded conditions were found to be 0.151 kWh and 0.1780 kWh respectively. Power requirement under loaded condition is 0.236 hp (Appendix IV). The results are shown in Table 4.5

Table 4.5 Energy requirement

Sl No.	No load (kWh)	Full load (kWh)
1.	0.150	0.1760
2.	0.152	0.1875
3.	0.152	0.1760
Average	0.151	0.1780

4.2.5 Germination test using sand method

Table 4.6 Germination percentage

Sl No.	Germination percentage	
	Manual	Mechanical
1.	77.0	85.0
2.	80.0	88.5
3.	71.4	82.8

Results of seed germination for both methods were studied under the same condition. It can be seen that the average seed germination of mechanically extracted seeds was 85.2% and that of manually extracted seeds were 76.1 %.

4.2.6 Speed of germination

Speed of germination of ashgourd seeds were studied for both methods.

Table 4.7 Speed of germination

Sl No.	Speed of germination	
	Manual method	Mechanical method
1.	10.06	11.50
2	11.44	12.37
3.	9.76	10.93

Results showed that the average speed of germination for machine extracted seeds was 11.6 and that of manually extracted seeds 10.4.

4.2.7 Root length and shoot length of the seedlings

The root length and shoot length observed as explained in 3.6.7 and 3.6.8 is presented in Table 4.8

Table 4.8 Root and shoot length of the seedlings

Sl No.	Root length of seedling (cm)		Shoot length of seedling (cm)	
	Manual	Mechanical	Manual	Mechanical
1.	9.3	6.7	9.7	8.6
2.	8.7	6.6	9.2	8.1
3.	9.1	7.2	10.6	8.7
Average	9.03	6.83	9.83	8.64

4.2.8 Vigour Index

A germination test is inadequate as far as prediction of stand establishment is concerned.This is primarily due to the fact that the artificial conditions created during testing is seldom available in field conditions. So vigour index was calculated for both methods of extraction and the results are presented in Table 4.9

Table 4.9 Comparison of vigour index obtained by manual and mechanical means

Method	Germination percentage (%)	Mean root and shoot length (cm)	Vigour Index
Manual	76.10	18.86	1435.2
Mechanical	85.16	15.47	1317.4

SUMMARY AND CONCLUSION

Vegetables are an important source of minerals, proteins and vitamins, which are highly essential and vital for human health. The per capita consumption of vegetables in India is far below the minimum dietary requirement. It therefore calls for a major research and development effort to increase the vegetable production commercially. The cucurbitaceous crops play a vital role in supply of the fresh vegetable and among them ashgourd occupies a prominent position. Commercial seed production of wet vegetables like ashgourd is quite expensive for want of suitable mechanical equipment for seed extraction. Manual seed extraction increases the cost of seed production. Besides, it is also troublesome to the labour engaged in seed extraction. Furthermore, delay in seed extraction leads to deterioration of seed quality.

The newly developed power operated ashgourd seed extractor consisted of flexible shaft, cutting blades, feeding and discharge mechanism, frame assembly and power transmission system. The extraction was done by moving the flexible shaft inside the ashgourd fruit with the hand. The machine was tested and its performance was evaluated. The capacity of the machine is 81.39 %with overall seed extraction efficiency of 97.5 %. The energy requirements of the machine with load and without load are 0.178 and 0.151 respectively. The germination percentage obtained by manual and mechanical method is 76.1 % and 85.2 % respectively.

Suggestions for future work

Some suggestions that may help future research work in modifying the ashgourd seed extractor are listed below:

1. The diameter of the flexible shaft could be increased to improve the load carrying capacity and the power transmission efficiency can be increased by slightly reducing the length of the flexible shaft.
2. Instead of solid bearings, ball bearings could be provided to avoid friction during the operation.
3. A cutting system can also be attached to the frame of the seed extractor

SYMBOLS AND ABBREVIATIONS

%	-	Percentage
/	-	Per
o	-	Degree
º C	-	Degree Centigrade
Agri	-	Agricultural
cc	-	Centimeter Cube
cm	-	Centimetre
Co	-	Coimbatore
Conc.	-	Concentrated
et al	-	And Others
FPME	-	Farm Power Machinery and Energy
g	-	Gram
GI	-	Galvanised Iron
h	-	Hour
ha	-	Hectare
HCl	-	Hydrochloric acid
hp	-	Horse power
KCAET	-	Kellapaji College of Agricultural Engineering and Technology
Kcal	-	Kilocalories
kg	-	Kilogram
kWh	-	Kilo watt hour
min	-	Minutes
ml	-	Millilitre
mm	-	Millimetre
MS	-	Mild steel
No.	-	Number
PHT & AP	-	Post Harvest Technology and Agricultural Processing
rpm	-	Revolution per minute
Rs.	-	Rupees
SAC	-	Supportive Allied Course
s	-	Seconds
t	-	Ton
Wt.	-	Weight

APPENDIX- I

Specifications of the newly developed power operated ashgourd seed extractor

1.	Overall length	-	600 mm
2.	Overall width	-	600 mm
3.	Overall height	-	900 mm
4.	Depth of V – groove	-	150 mm
5.	Width of V- groove	_	250 mm
6.	Length of V-groove	_	250 mm
7.	Angle of V- groove	_	80 º
8.	Thickness of the blade	_	2 mm
9.	Diameter of blades	_	65 mm
10.	Number of the blades	_	2
11.	Number of teeth on each blade	_	10
12.	Width of teeth	_	6 mm
13.	Depth of teeth	_	10 mm
14.	Length of flexible shaft	_	1500 mm
15.	Inner diameter of flexible shaft	_	5.5 mm
16.	Outer cover diameter of flexible shaft	_	11 mm
17.	rpm of flexible shaft	_	240
18.	Diameter of motor pulley (driver pulley)	_	50 mm
19.	Diameter of driven pulley	_	300 mm
20.	Centre to centre distance between the pulley	–	390 mm
21.	Diameter of the rotor shaft	-	21 mm
22.	Length of the rotor shaft	_	520 mm
23.	Diameter of the solid bearing	-	21 mm
24.	Height of the frame from the base of the motor	_	750 mm
25.	Height of the supporting frame for rotor shaft from the motor base	–	450 mm

26.	Type of belt	-	V-belt
27.	Size of the belt	_	B- 52

APPENDIX -II

Calculation of operating cost

Cost of the machine (including motor)	= Rs. 6500
Capacity of Extractor	= 81.39 kg / h
Power requied to operate the extractor	= 0.5 hp

Assumptions

Useful life of the unit	= 8 yrs
Working hours per day	= 6 h
No. of working days per year	= 1800 h
Salvage value	= 10 %
Interest rate	= 12 %
Repairs and maintenance	= 10 %
Labour charges	= Rs. 200

Fixed cost

Depreciation $= \frac{C - L}{L \times H}$

$= \frac{6500 - 650}{8 \times 1800}$

= Rs. 0.406 /h

= Rs. 731.25 / year

Interest on investment $= \frac{[C + S] \times 12}{2 \times H \times 100}$

$= \frac{[6500 + 650] \times 12}{2 \times 1800 \times 100}$

= Rs. 0.24 / h

= Rs. 429 / year

Total fixed cost = Rs. 0.646/ h

= Rs. 1162.8/ year

Variable cost

1. Repair and maintenance = $\frac{6500}{10 \times 1800}$

= Rs. 0.45 /h

= Rs. 650/ year

2. Cost of electicity = 0.178 x 1800 x 2

= Rs. 640.8/ year

= Rs. 0.356/ h

3. Labour charge (one person) = Rs. 33.33/ h

Total variable cost = Rs. 34.136 / h

= Rs. 62607.60 / year

Total operating cost = fixed cost + variable cost

= Rs. (1162.8 + 62607.60)

= Rs.63206.40 / year

= Rs. 34.78 h

= Rs 0.43 / kg

Manual cost

Labours required = 1

Working hours = 6 h

Capacity = 300 kg / day

= 37.5 kg / h

Labour charges = Rs. 200/person

Total labour charges = Rs.33.33/h

= Rs 0.89/ kg

Percentage saving = [0.89 – 0.43/0.89] x 100

= 51.68 %

APPENDIX- III

Main parts of the ashgourd seed extractor and their material of construction is given

Sl No.	Parts	Material of Construction
1.	Frame	Angle iron of MS
2.	Shaft	MS
3.	Pulley	Cast iron
4.	Solid Bearing	MS
5.	Nut and bolt	MS
6.	Outer cover	GI
7.	Blade	MS
8.	Flexible shaft	MS with nylon coating

APPENDIX-IV

Power requirement

Load condition

From energy meter specification

2400 revolution of energy meter disc	=	1 kWh
Time taken for 1 revolution of the energy disc	=	8.5 s
No. of revolution in an hour	=	3600/ 8.5 = 435.52
Energy requirement to operate the machine in an hour	=	435.52/2400
	=	0.1764kWh
Power requirement	=	.1764/1
	=	.1764/ .764
	=	.236 hp

REFERENCES

Abdul- Baki, A.A and Baker, J.E .1973. Are changes in cellular organelles related to vigour loss in seeds. *Seed Sci.Technol.,* 1: 89-92

*Agong, S.G. 1993. Seed extraction procedure for long term conservation of *Solanum nigrum*. *Seed science and technology*, 21: 447 – 451

Agrawal, R.L .1980. *Seed Technology*. Oxford and IBH Publishing Co., New Delhi: 507

Anonymous. 2002 Economical Survey of India 2001-2002

Deepthi Susan, P.E., Jacintha, T., Joseph, K and Mansoor Ali, K.L. 1993. Fabrication and testing of a power operated axial flow seed extractor. Unpublished B. Tech project work, Kerala Agricultural University, Thrissur.

Devadas, C.T.,Sivakumar, S.S and Gothendapani, L. 1993.Tomato seed extractor. *Invention Intelligence*, April: 139-140.

Gabani, S.H and Siripurapu S.C.B. 1993. Chilly seed extractor. *Spice India*.September: 5-8

Jacqueline, A.S .1984. Studies on certain aspects of production, processing and storage of Brinjal (*Solanum melonginal*) seed. Unpublished Ph.D. thesis work, Tamil Nadu Agricultural University, Coimbatore.

Kachru, R.P., Srivastava, K., Bisht, B.S and Ojha, T.P. 1986. IARI Tomato seed extractor.100 Bankable post harvest equipments developed in India: 148-149

Kannath, B. 1996. Effect of fruit maturity, seed processing and storage methods on seed quality of ashgourd [*Benincasa hispida* (Thumb.)].. Unpublished M.Tech thesis work. Kerala Agricultural University, Thrissur.

Kingsly, A.R.P. 1998. Fabrication and performance evaluation of brinjal seed extractor. Unpublished M.E thesis work, Tamil Nadu Agricultural University, Coimbatore

Maguire , J.D. 1962. Speed of germination aid in selection and evaluation for seedling emergence and vigour. Crop Sci .2: 176-177.

Mohanty, S.K., Nanda, S.K. and Das, D.K. 1997. Design, development and testing of a low cost vegetable seed extracting machine. *Agricultural Mechanisation in Asia, Africa and Latin America*, 28(4) : 53-56

Mohsenin, N.N. 1970. Physical properties of plant and animal materials. Gordon and Breach Science Publisher, New York: 65-70

Nayar ,N.M and More, T.A. 1998.*Cucurbits.*Oxford and IBH Publishing Co., New Delhi ,113

*Nicholas, L .1971. A machine for vegetable seed extraction. *J.Agrl.Engg*, ISAE, 8 (3) : 87-91

Praveen, K.B.1999. Fabrication and performance evaluation of tomato seed extractor. Unpublished M.E.thesis work. Tamil Nadu Agricultural University, Coimbatore

Peter, K.V., Sadhan, K., Mini, P.G and Prasanna, K.P. 1991. Ashgourd. *Indian Horticulture*, 36 (2) :35

*Raymond, A.T.G. 1985. Vegetable seed extractor. Longman Publishers, London: 223- 229

Reed, G.L. 1980. Pressure sprayer eliminates fermentation process for cleaning muskmelon seeds. *Hort. Science* 16 (2): 1-91

Ritchie, D.B. 1971. Tomato seed extraction. *Hort. Res*., 11:127-135

Verma , S.R., Harisingh and Kalkat ,H.S. 1992.Design aspects and performance of an axial-flow vegetable seed extracting machine. Agricultural mechanization in seed extracting machine. *Agricultural mechanization in Asia, Africa and Latin America*, 23 (2): 21-24, 28

*Wehner, T.C., Tolla, G.E and Humphires, E.G. 1983. A plot scale extractor for cucumber seeds. *Hort. Science,* 18 (2): 246-247

*Wehner, T.C and Humphires , E.G. 1995. A single fruit seed extractor for cucumbers. *Hort. Technology.*, 5 (3): 268 –273

Yawalkar, K.S. 1985.Vegetable crops of India. Agri Horticultural Publishing House, Nagpur, 124-126

* Original not seen

DEVELOPMENT AND TESTING OF A POWER OPERATED ASHGOURD SEED EXTRACTOR

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ABSTRACT OF THE PROJECT REPORT
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ABSTRACT

A power operated ashgourd seed extractor was developed, tested and its performance was evaluated. The major parts were flexible shaft, cutting blades, V-groove, seed outlet and collecting drum and an electric motor with a speed reduction unit of 6:1. The extraction took place due to the scraping and scooping action of the cutting blades inside the fruit. The capacity and the seed extracting efficiency were found to be 81.39 kg per hour and 97.5 % respectively at an optimum speed of 240 rpm. The ashgourd seeds showed the germination capacity of 85.5 % and 76.1 % by mechanical and manual means respectively.