

Design and Fabrication of Little gourd cutter

K. Rajesh¹, A.Hrudaya², K. Sai Swetha³, Y. Prashanth⁴, L.Raju Babu⁵

¹College of Food Science and Technology, Bapatla, Andhra Pradesh

Email: krajeshgowda@gmail.com

²College of Food Science and Technology, Bapatla, Andhra Pradesh

Email: avulahrudaya1998@gmail.com

Abstract— Plywood base was used as a platform to place the entire equipment. Stainless steel blade was attached to the shaft of motor of 240V which acts as cutting unit. Stainless steel cylinder with supporting iron rod is used for feeding little gourds. A rectangular frame made up of metallic stands was used as main frame and supporting main units. A collection tray made up of metal sheet was used for collection of slices.

Moisture content of little gourds was 85%. The dimensions of little gourds were measured using digital Vernier callipers and weight of each little gourd was measured using electronic weighing balance. Average length and diameter of little gourds were found to be 17.93mm and 18.88mm respectively. The other parameters like Sphericity, roundness, cylindrical and elliptical were found to be 0.14cm, 3.73cm², 19.87cm³ and 0.89cm⁻³ respectively. Average weight of the little gourds were found to be 16.5g. The surface area and bulk density of little gourds were found to be 180.6 sq.cm and 500 kg/m³. Performance evaluation of little gourd cutter was performed where slicing operation was performed at different motor speeds and voltages. High motor speed with voltage of 240V gave slices of 0.75mm which were suitable for household consumption.

Keywords— gourd cutter, Plywood, *Coccinia grandis*.

I. INTRODUCTION

Coccinia grandis, the little gourd is popularly known as scarlet gourd, ivy gourd, baby watermelon and kowai. It is a tropical vine belonging to the family of Cucurbitaceae. It prevents kidney stones, fatigue and protects the nervous system. It maintains healthy metabolism and the fiber present in the little gourd keeps the digestive tract healthy. Little gourd is widely used for medicinal and anti-oxidant properties. It is used in Ayurvedic formulation for centuries as an immunity defender and anti-triglyceride agent. It acts as a medicine to cure bronchitis, asthma, jaundice, leprosy, etc. It is a strong

source of carbohydrates, proteins, fiber, calcium, potassium and iron.

The little gourd plant is a native plant in Asia and Africa. It grows naturally in many areas such as India, Philippines, Myanmar, and Thailand etc. In India, the little gourd has been mostly consumed as a curry, by deep-frying it along with spices, stuffing it with *masala* and sauteing it, or boiling in a pressure cooker followed by frying. They are best when cooked, and are often compared to bitter melon. In Thai cuisine, it is one of the ingredients of the very popular clear soup dish *kaeng jued tum lueng* and *kaeng lieng* curry.

Little gourd is featured with the ability of detoxification and it acts as ideal in cleaning human blood. Little gourd has the anti-bacterial properties but also the pain killing and anti-ulcer properties. The plant of this vegetable is used to control high fever and bowel problems. People suffering with high cholesterol levels are suggested to take the little gourd along with their diet in order to hold it in control.

As the little gourds are small in size, it is difficult for cutting in short time. Mostly little gourds are processed by manual cutting which is common in hostels, educational institutions, catering services and in restaurants. For small scale production, a household and user-friendly cutter is required.

The existing vegetable cutting machines in market are automatic, which operates on the concept of rotating grid which are not specific for little gourd and costs nearly about 1.5-5 lakh. For a middle-level business like catering services, hotels, it is a high investment.

Considering the size and shape of the little gourd, it is difficult to cut through vegetable cutters. There is a need to design a model for easing the work load, which minimize the cost of equipment and suit for cutting little gourd. In this connection an attempt was made to design a medium size little gourd cutter to cut little gourd into pre-defined size and make it semi-automatic with following objectives:

1. Design a semi-automatic little gourd cutter for medium sized little gourds
2. Performance evaluation of design to assess its suitability for small scale industries
3. Cost estimation of little gourd cutter

The proposed development of a little gourd cutter could alleviate the problems faced by manual cutting. The machine will be reducing the time of cutting of little gourd.

II. MATERIALS AND METHODS

Materials used were medium sized little gourd, stainless steel cylinder for feeding, blades for cutting, motor and belt driven pulleys, iron angular rods for making stands (shaft holding and tray holding), plywood for base, metal sheet for design of collection tray, variable voltage transformer. These materials were procured from local hardware shop of Bapatla and developed in local workshop.

Fresh little gourds of medium size were procured from vegetable market of Bapatla, Guntur dist., A.P. Little Gourds procured were graded and thoroughly washed and preserved in cool dry place to avoid pest attack.

Moisture content of little gourd slices was measured by hot air oven method. One sample of little gourd slices, 10 g was taken into moisture box and placed in hot air oven (Yorco, Model: YSI-431) at 100-105°C with lid open until constant weights were obtained and then cooled in a desiccator with closed lid for 15 min. weight of the sample was taken when weight remained constant (AOAC, 2000). And calculated by using formula

$$MC = \frac{\text{Initial Weight of Sample} - \text{Final weight of sample}}{\text{Initial weight}} \times 100$$

Dimensions of little gourd were useful in designing cutting machine as size affects the cylinder diameter, design characteristics and knife orientation. These are important properties to describe an object satisfactorily. Size is the measurement of dimensions while shape is the rigid form of the body. The dimensional characteristics of the material are called size. Five little gourds were randomly selected and the two principal dimensions (length and diameter) of little gourds were measured using digital Vernier calipers with an accuracy of 0.1mm (Mitutoyo, Model CD-6''CSX).

The Sphericity, cylindrical, roundness, elliptical shape of little gourd were calculated using the following formulae.

$$\text{Sphericity} = \frac{D_i}{D_c}$$

$$\text{Roundness} = \frac{4\pi r^2}{3}$$

$$\text{Cylindrical, } V = \pi r^2 h$$

$$\text{Elliptical} = \frac{4\pi}{3ab^2}$$

Where,

D_i = diameter of largest inscribed circle

D_c = diameter of smallest circumscribed circle

r = radius i.e., half of the diameter of largest inscribed circle

h = height of the little gourd

a = diameter of the largest inscribed circle,

b = diameter of the smallest circumscribed circle

Weight of little gourd and little gourd slices were measured using electronic weighing balance (Ohaus, PAG213) with an accuracy of 0.001g. The doors of weighing balance were closed, and sample weight was measured.

Surface area was calculated by measuring the weight of little gourd using electronic weighing balance. Surface area was given by the formula (Reference: Physical properties of biological materials by O.P.SINGHAL and D.V.K.SAMUEL). The values obtained were converted into 'm²'

$$\text{Surface area, } S = 4.82W^{0.66}$$

Where,

S = Surface area in sq. m

W = weight, in g

Little gourds were placed in a beaker of known volume and the weight of little gourd that fit into the beaker was taken. Bulk density of little gourd was calculated using the formula:

$$\text{Bulk Density} = \text{Mass (kg)} / \text{Volume (m}^3\text{)}$$

III. MATERIALS USED IN FABRICATION OF LITTLE GOURD CUTTER

Semi-automatic little gourd cutter consists of stainless steel blades for cutting, a hollow stainless-steel pipe for feeding, motor with DC electric source. Motor is attached to a shaft with a belt driven pulley. The blade is fixed to the shaft positioned inside two ball bearings resting on frame. The shaft gets the drive from motor with pulley and V-belt attached to shaft. A stainless-steel tray is used for collection of slices which is placed under the cutting blades with angle iron support. Variable voltage transformer was used to regulate RPM of shaft.

The two types of blades made up of stainless steel are used to cut the vegetables. One type of blade consists of one cutting edge where as another type consists of two cutting edges on either sides. The primary cutting edge of blade is close to the standard circular arc, with an angle 22°C which is helpful in improving the cutting efficiency of machine. The blade is fixed to the shaft placed inside two ball bearings resting on frame, which is beside the feeding pipe. The performance of cutting tool mainly depends on

the geometry of cutting blade, physical properties and the operating conditions (such as speed and thickness).

A stainless steel pipe is used to feed the vegetables. It is horizontal to the plane of base. It is placed exactly at 90° to the cutting blade with the help of iron rod which is at a height of 15cm from the base. The cylinder is formed into semi-circular shape to make feeding convenient to the user. The length of the stainless steel cylinder is 30cm and the diameter is 2.5cm. The cylinder is shaped into semicircle which is of length 25cm and the 5cm is remain as circular shape to avoid outflow of vegetables.

Metallic stands of thickness 2.1cm are used to place the driving mechanism of shaft and to hold the tray.

Dimensions of metallic stand used to place the shaft: Length = 27cm, Height = 20cm, Width = 12.5cm

Dimensions of metallic stands used for holding the tray: Length = 30cm, Height = 5cm

The shaft with length of 15cm and diameter of 2.5cm is placed on metallic stand with the help of two ball bearings. The shaft gets the drive from motor with pulley and V-belt attached to shaft.

A motor capacity of 240V with varied rpm is placed in the corner of the base with DC electric source. The key shaft of length 5cm is connected to the motor to attach the pulley. The pulley rotates through the shaft with the help of belt driven mechanism.

A Variable voltage Transformer is used to control the RPM of motor by regulating the voltage. It is simple to operate and controls are available for automatic adjustment to maintain "constant" (regulated) voltage output.

A metal sheet with length 50cm, width 40cm and thickness 2.2cm was bent at an angle of 90° and at a length and width of 10cm on four sides to make a collection tray. The volume of collection tray was 6000cm^3 .

Dimensions of collection tray: Length = 30cm, Width = 20cm, Thickness = 2.2cm

IV. FABRICATION OF MACHINE

Little gourd cutter consists of four units: platform and main frame, feeding mechanism, blade mechanism, collection mechanism.

A plywood of dimensions $55 \times 55\text{cm}$ and thickness 1.5cm is used as a platform to place the whole equipment. The main frame includes motor, pulley, shaft and bearing. A motor of capacity of 240V is placed at a distance of 18cm from the corner and the key shaft of length 5cm is connected to the motor shaft to attach the pulley. A variable voltage transformer is used to control the RPM of the motor. The shaft of length 15cm and diameter 2.5cm is

placed on rectangular frame made up of metallic stands of length 27cm, height 20cm and width 12.5cm at a distance of 5.5cm from both sides. The shaft gets the drive from motor with pulley and V-belt attached to shaft. A rectangular frame (made up of metallic stands of length 27cm, height 20cm and width 12.5cm) is placed at a distance of 26.5cm from one side and 13 cm from another side of the corner and is used to place the shaft and feeder. One side of shaft is facilitated to hold and give drive for the blade whereas other side of the shaft is to hold the pulley. The pulley of length 30cm rotates through the shaft with the help of belt driven mechanism. Two ball bearings are used to hold the shaft and is placed on the rectangular frame at a distance of 4cm from shaft (both sides).

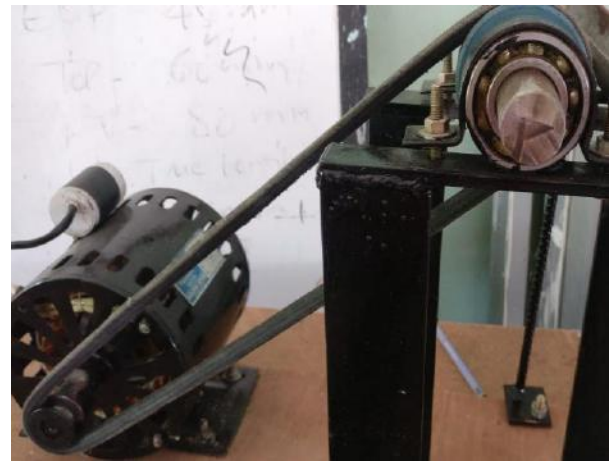


Fig.1: Main Frame

The feeding mechanism consists of a stainless steel pipe of length 30cm and diameter 2.5cm used as a feeder which is horizontal to the plane of base. The feeder is placed on a rectangular frame at a distance of 4cm from the shaft with the help of iron rod at height of 26cm from the base. The feeding pipe is made into a shape of semicircle at the length of 25cm and 5 cm was remained as a circular shape. This provision is made to allow easy flow of vegetables from feeder to the blade.

The blade mechanism consists of two types of blades made up of stainless steel are used to cut the little gourd. One type of blade consists of one cutting edge where as another type consists of two cutting edges. The primary cutting edge of blade is close to the standard circular arc, which is helpful in improving the cutting efficiency of machine. The blade is fixed to a hollow ring and shaft placed inside two ball bearings resting on frame, which is beside the feeding pipe. The performance of cutting tool mainly depends on the geometry of cutting blade, physical

properties and the operating conditions (such as speed and thickness).

The collection tray is made up of metal sheet with length 50cm, width 40cm and thickness 2.2cm was bent at an angle of 90° and at a length and width of 10cm on four sides to make a collection tray of length 30cm, breadth 20cm and height 10cm is placed on metallic stands of length 30cm at height of 5cm from the base and is at a distance of 25.5cm and 11.6cm from either sides of the base. The collection tray is placed under the blades which is at a distance of 7cm from the blade. A provision is made in order to prevent the overflow of slices. A metal sheet of length 20cm and height 8cm is placed at the back side of the blade section on the rectangular frame which is at a distance of 5cm from the blade and the three square shaped fiber sheets of dimensions 15×15cm and thickness of 0.5 cm are placed on front side and on either sides of the blade at a distance of 5cm from either sides of the blade and at a height of 2cm from the collection tray. This provision allows flow of slices directly into the collection tray. It prevents slipping of slices off the collection tray.

Performance evaluation of machine

Fabricated little gourd cutter was run at varied voltage and varied rpm of shaft and different moisture content. The slice thickness and time for each operation was noted which would conclude the needed speed for perfect slice thickness.

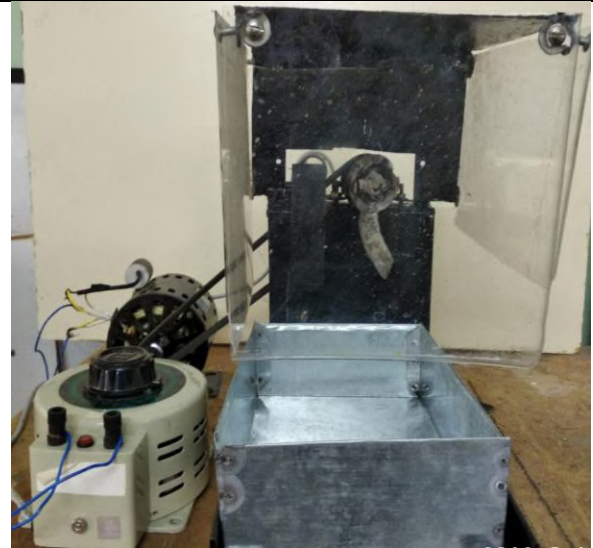


Fig.3: Little gourd cutter (Front view)

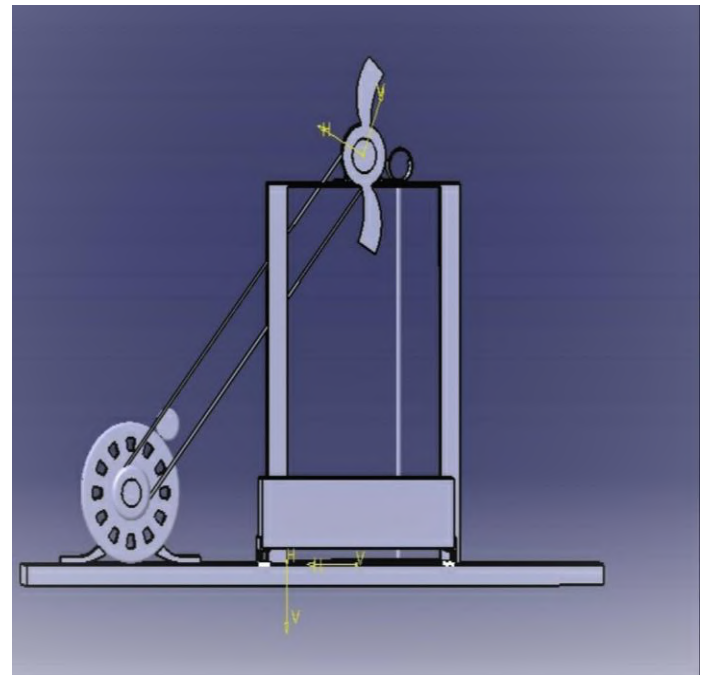


Fig.4: AutoCAD of little gourd cutter (Front view)



Fig.2: Little gourd cutter (Side view)

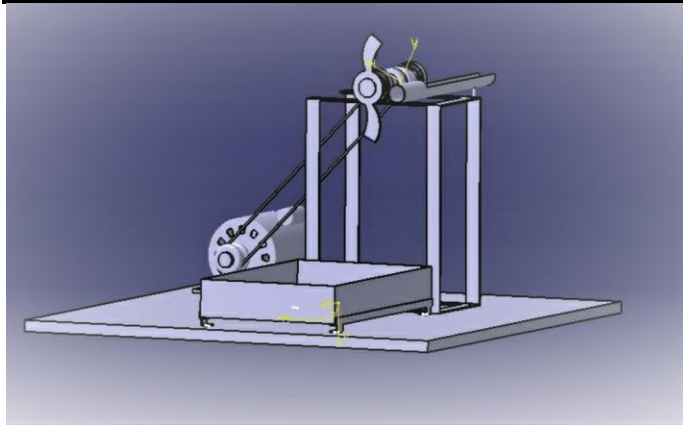


Fig.5: AutoCAD of little gourd cutter (Isometric view)

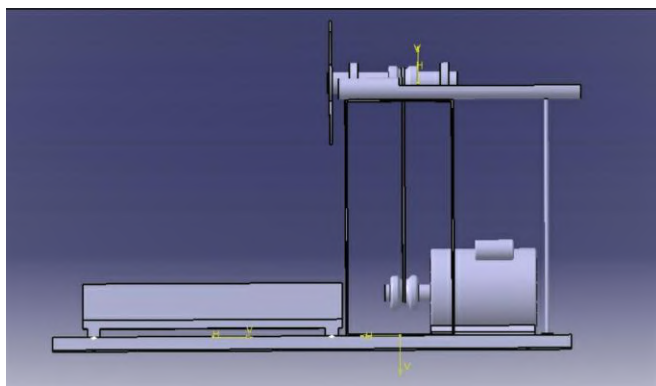


Fig.6: AutoCAD of little gourd cutter (side view)

V. RESULTS AND DISCUSSION

Moisture content of little gourds was 85%. The dimensions of little gourds were measured using digital Vernier calipers and weight of each little gourd was measured using electronic balance. Average length and diameter of little gourds were found to be 17.93mm and 18.88mm respectively.

The other parameters like Sphericity, roundness, cylindrical and elliptical were found to be 0.14cm, 3.73cm², 19.87cm³ and 0.89cm³ respectively. Average weight of the little gourds were found to be 16.5g. The surface area and bulk density of little gourds were found to be 180.6 sq.cm and 500 kg/m³.

Performance evaluation of little gourd cutter

Feed of little gourds in stainless steel cylinder was run at varied motor speeds like high (680rpm), medium (550rpm) and low (450rpm) and varied voltages of 160V, 150V and 140 V and slice thickness. At that particular motor speed triplicates of slice thickness values were taken and average thickness was calculated.

Table.1: Slice thickness at varied voltage and shaft speed

S.no	Voltage (V)	Shaft speed(rpm)	Slice thickness	Mean
1.	160 V	680	a. 3.7 b. 3.6 c. 3.8	3.7
2.	150 V	550	a. 4.9 b. 4.3 c. 4.8	4.3
3.	140 V	450	a. 4.9 b.5.2 c.5.1	5.1

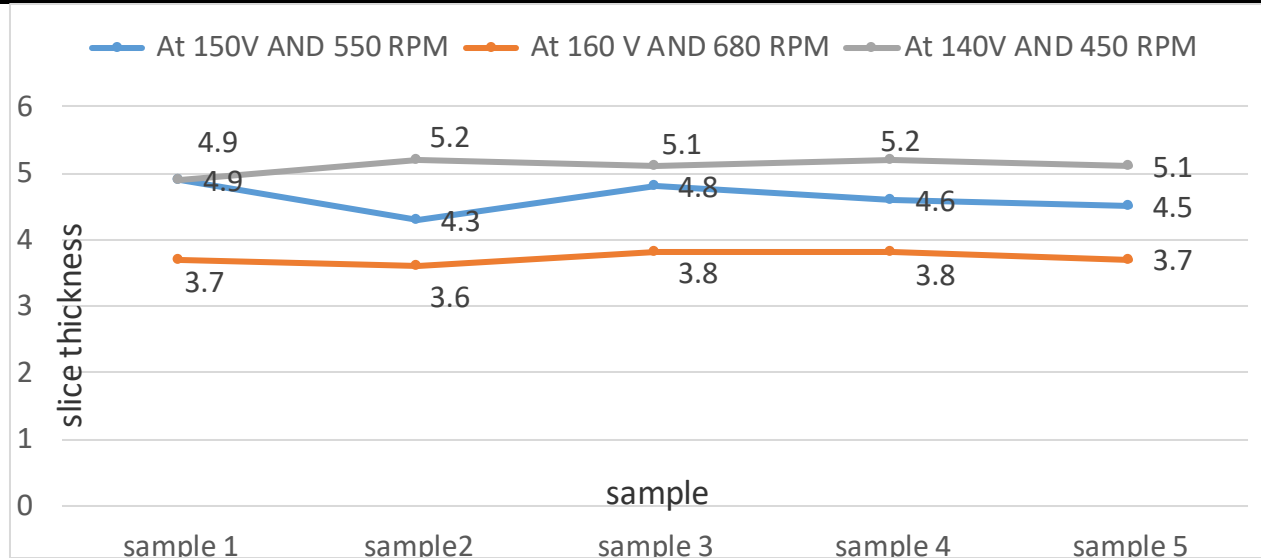


Fig.7: Slice thickness at varied voltage and motor speed

From the fig, it was observed that at a voltage 160 V AND 680 RPM slice thickness is 3.7 and are small when compared to other speeds and voltage. Both 150 V and 140 V yielded slices of thickness 4.3 and 5.1 respectively.



At 160 V

At 150 V

At 140 V

Fig.8: Slices chopped at different voltage

Performance evaluation of cutter at different moisture contents:

Performance evaluation of little gourd cutter at different moisture content of little gourd was done at optimum voltage and thickness. From the above graph we observe optimum and uniform slice thickness is observed at 160 V and 680 RPM. The moisture content was decreased by using hot air oven drying method.

Slice thickness at 160 V and at a moisture content 80%

Little gourds were brought to a moisture content 80% by drying in hot air oven for 30 min. Little gourds with moisture content 80% were fed into the machine and blade was rotated at varied motor speeds of 680 rpm. At that particular motor speed triplicates of slice thickness values were taken and average thickness was calculated.

Table.2: Slice thickness at voltage 160 V and moisture content 80%

S.no	Voltage (V)	Shaft speed(rpm)	Slice thickness	Mean
1.	160 V	680	a. 2.31 b. 1.93 c. 1.29	1.83

Slice thickness at 160 V and at a moisture content 70%

Little gourd were brought to a moisture content 70% by drying in hot air oven for 1hr. Little gourds with moisture content 70% were fed into the machine and blade was rotated at varied motor speeds of 680 rpm. At that particular motor speed triplicates of slice thickness values were taken and average thickness was calculated.

Table.3: Slice thickness at voltage 160 V and moisture content 70%

S.no	Voltage (V)	Shaft speed(rpm)	Slice thickness	Mean
1.	150 V	550	a. 1.84 b. 1.32 c. 1.41	1.52

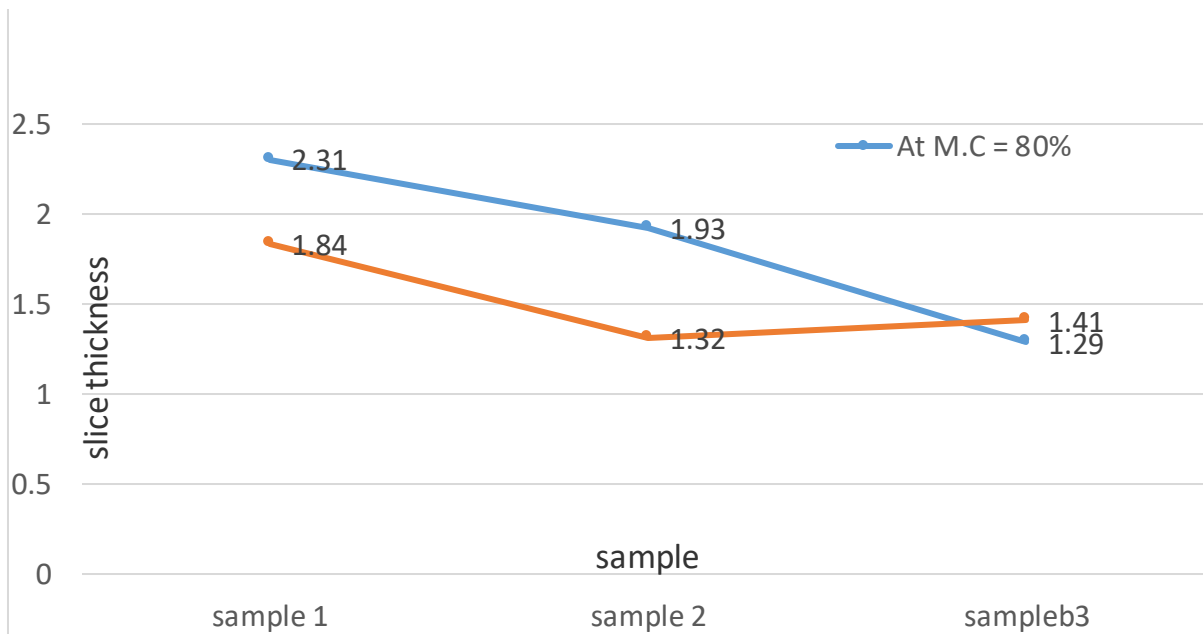


Fig.9: Slice thickness at a voltage 160 V and different moisture content

From the fig, it was observed that as the moisture content decreases slice thickness also decreases

Cost evaluation of little gourd cutter:

Approximate Cost of cutter was ₹ 2,990/-.

The cost of each material was given in the **table 4**

Table.4: Cost of little gourd cutter

Materials	Cost (In Rs)
Motor	1000
Metal rods	200
Stainless steel pipe	120
Pulley	300
Bearings	100
Plywood Base	120

Belt	30
Blade	250
Shaft	160
Collecting tray	150
Workmen	200
Welding and threading charges	300
Total	2,990/-

Cost to run little gourd cutter

Equipment was run for 8 hrs in a day and about 120kg of little gourd was chopped and the power consumption was 2 units per hour and price was Rs. 5/unit. Then the cost incurred for cutting for 1hr is given in the **table 5**

Table.5: Cost for little gourd cutting for 1 hour

Expenses	Cost for 1 day (In Rs.)	Cost for 1 hr. (In Rs.)	Cost for 1 kg (In Rs.)
Workmen	350	43.75	1.75
Power	80	10	0.4
Total	490/-	55.75/-	2.15/-

The capacity of machine is 15 kg/hr when little gourd are fed continuously in the feeding barrel and the cost incurred for cutting 1 kg little gourd is ₹ 2.15/-.

VI. SUMMARY AND CONCLUSIONS

Moisture content of little gourds was 85%. The dimensions of little gourds were measured using digital Vernier callipers and weight of each little gourd was measured using electronic balance. Average length and diameter of little gourds were found to be 17.93mm and 18.88mm respectively. The other parameters like Sphericity, roundness, cylindrical and elliptical were found to be 0.14cm, 3.73cm², 19.87cm³ and 0.89cm³ respectively. Average weight of the little gourds were found to be 16.5g. The surface area and bulk density of little gourds were found to be 180.6 sq.cm and 500 kg/m³. Performance evaluation of little gourd cutter was performed where slicing operation was performed at different shaft speeds and voltages and at different moisture contents. High shaft speed with voltage of 160V at gave slices of 3.7mm which were suitable for household consumption. We observed that as the moisture content decreases the slice thickness also decreased. The capacity of little gourd cutter is 12 kg/hr. Cost of cutter was ₹ 2,990/-.The cost incurred for cutting 1 kg little gourd is ₹ 2.15/-

- [3] Obeng G Y (2004) Development of mechanized plantain slicer. *Journal of Science and Technology* Vol.: 24, No.: 2, 2004 [Page 126-133].
- [4] Owolarafe K, Muritala OA, Ogunsina B S (2007) Development of an Okra slicing device. *Journal of Food Science and Technology* Vol.: 44, No.: 4, 2007 [Page426-429].
- [5] Suryanto H, Ahmed D, Yahya A, Akande F B, Syahrita K (2009) Cutting Tests of Oil Palm Empty Fruit Bunches. *Transactions of the American Society for Agricultural & Biological Engineering* Vol.: 52, No.: 3, [Page 723-726].
- [6] Megan R (2008) Development of multipurpose slicer. *American society of Agricultural Engineers (ASAE)* page 31-37.
- [7] Aziz Ab I, Shafie, Latifah M N, Azlan O (2011) Development of a Slicing Machine for Fresh-cut Pineapple. *Acta Horticulturae* No.: 902.
- [8] Kaveri. G and Thirupathi. V, Studies on Geometrical and Physical Properties of CO 4 Onion Bulb (*Allium cepa* L.). *International Journal of Recent Scientific Research* Vol. 6, Issue. 3, pp.2897-2902, March, 2015.

REFERENCES

- [1] O.P.SINGAL, Engineering properties of biological materials by D.V.K.Samuel.
- [2] Neidhardt J C (2008) Development of Tomato slicer. *Journal of Fujian Agricultural science and Technology* 3: 16-17.