

Development of peeling machine for ginger, potato and sweet potato

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■ **ABSTRACT** : In India agriculture is the most important sector for their economy. Agriculture area of India is tropical so several tropical crops are cultivated like fruit and vegetable, from tubers and roots below the surface of the soil. In this tuber and root crop major crops are potato, sweet potato, beet, ginger and other. Being high level of heterogeneity in the structure. Peeling processes face a numerous problems. The root and tuber crops are produced in significant amount in India and world. This project is aimed at a development in mechanization of peeling systems for the root and tuber crops in food processing related industries and at house hold. The peel of ginger, potato and sweet potato's removed by many methods like manual or mechanical are most popular methods. The work of project performance is compare to the manual peeling. Consider this problems and develop the peeling machine, also consider their physical properties of ginger, potato and sweet potato. Mechanical peeling compares with a time of manual peeling In this project mechanical peeling are examine the three different rpm, they are 80 rpm, 100 rpm and 120 rpm to peel the ginger, potato and sweet potato. The perform evaluation of 80 rpm, 100 rpm and 120 rpm speed of disk on different time upto complete the peeling process. At that time increase the rpm more 20 rpm, this speed change the time of peeling less than 80 rpm and 100 rpm. This speed gate time less than 1 to 2 min.

■ **KEY WORDS** : Peeling, Peeling machine, Ginger, Potato, Sweet potato

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India is a tropical agricultural country. So tubes and root vegetable crops are cultivates potato (49344 MT), sweet potato (1465 MT), onion (21402 MT), radish (3174 MT), carrot (1446 MT) and other as well as in spice tuber and roots crop like ginger (1075 MT), turmeric (1061 MT) and other (Agricoop, 2018). But India the insufficient or lack of processing on vegetables and fruits they are under goes to spoils or wasted.

Ginger :

Ginger (*Zingiber officinal*) is a tropical

monocotyledon and herbaceous perennial specie belonging to the order *Scitamineae* and family *Zingiberaceae*. It is oldest rhizome widely domesticated as a spice. India is a leading producer of ginger in the world and during 2012-13 the country produced 7.45 lakh tonnes of the spice from an area of 157839 hectares (ICAR, 2017).

Potato :

Potatoes are rich in several micronutrients, especially vitamin C – eaten with its skin, a single medium

sized potato of 150 g provides nearly half the daily adult requirement (100 mg). The potato is a moderate source of iron, and its high vitamin C content promotes iron absorption. It is a good source of vitamins B1, B3 and B6 and minerals such as potassium, phosphorus and magnesium, and contains folate, pantothenic acid and riboflavin (FAO, 2008).

Sweet potato :

It is native to tropical areas. The sweet potato could be considered as an excellent novel source of natural health-promoting compounds, such as β -carotene and anthocyanins, for the functional food market (Chakraborty *et al.*, 2017). It is large, starchy, sweet-tasting, tuberous root vegetable. It is native to tropical areas including Central and South America (Lynn and Eric, 2014). It is nutritious root crop that contains significant amounts of fibre, β carotene and vitamin C, particularly in varieties with highly colored roots. Protein contents of sweet potato leaves and root range from 4.0 per cent to 27.0 per cent and 1.0 per cent to 9.0 per cent, respectively (Chakraborty *et al.*, 2017).

Peeling :

Peeling is one of the integral parts of a food processing, and the majority of agricultural crops need to be peeled in order to remove at the initial stage of food processing (O'Beirne *et al.*, 2015). The quality and shelf-life of fresh-cut produces could be compromised with the peeling (Tapia *et al.*, 2015). In general peeling process the best characteristics are following: Minimizing product losses, less chemical usage, Minimizing energy, Minimizing heat ring formation, Minimizing pollution load.

Objective :

- To development of multifunctioning peeling machine for ginger, potato and sweet potato.
- To perform evaluation of peeling machine.

Methodology of the project :

- To study the research papers on the peeling mechanisms of the ginger, potato and sweet potato. Analytical design calculations of the project for selecting the material of the project and design the project.
- Material selection of project such as motor. Power consumption, material of steel for the fabrication.
- To fabricate the project and test the results over

different food materials.

■ METHODOLOGY

The main purpose of developing this peeling machine is for high efficiency, less damage, affordable and easy handling.

Pulley and belt mechanism:

In this project the input load is of food material which are not in fixed dimensions as we know but I am going to design the machine for the 5 kg of weight so the torque of the machine will have to be able to lift the load of plate top rotate the plate with the maximum of 5 kg plate.

Gear box (worm reducer):

A worm gear reducer is one type of reduction gear box (15:1) which consists of a worm pinion input, an output worm gear, and features a right angle output orientation. With a high ratio of speed reduction and high torque output multiplier, it's unsurprising that many power transmission systems make use of a worm gear reducer.

Round SS plate:

The round plate is used to rotate the food materials place inside the tank and the plate must be bending from the one side to imbalance the food material with the proportional speed of the pulley output. The material of the plate is food grade 304 stainless steel.

Round M S bar:

The round bar is used to rotate the plate. The pulley attached to the round bar and it is mounted in the bearing structure.

Nylon bush:

Nylon bush is attached to the plate to move the potato or material inside the tank efficiently with the more centrifugal force in the machine.

Machine frame:

The machine frame is made up of mild steel which is attached by screw shaft and one motor is fitted. The two design factors considered in determining the material required for the frame are weight and strength. This frame machine supports all the material and also carries the weight of the machine as well as component.

Bearing:

To mount the round bar bearing pedestal is used which is UCF 204. This is bearing housing mounted to rotate the round plate in the bearing by the motor.

Tank:

The tank is made up of Stainless steel. The tank is coated by the abrasive particles from the inside to resist the rotational flow of food material placed inside the tank.

SS net sheet:

The SS net sheet is used to make a drainage system, when continuous spray of water from the above of tank and due to the friction of food material inside produces the waste which is removed from the drainage.

A.C. electric motor:

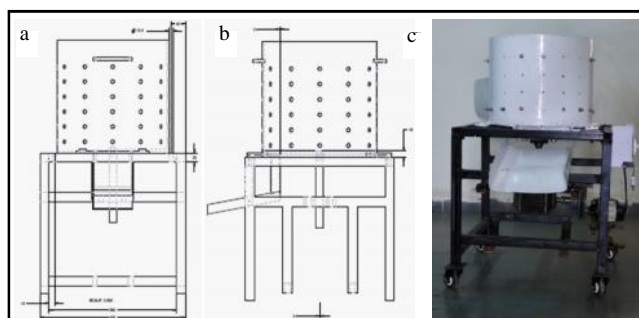
The A. C. electric motor is attach to the pulley and belt mechanism. The gearbox attached electric motor by attach to the pulley and belt mechanism and gearbox shaft direct attach to moveable disk used for peeling operation and other gander material like speed regulator, grub screw, nut bolt, switch and stand etc.

Working methodology of developed machine for peeling:

As per the design data, various parts of machine was developed by using various mechanical operations and machines like lathe, grinder, cutter, drill tool, etc. the development work was started with the collection of parts for assembly then mechanical operations was carried out. The M S cylinder drilling is done on outer wall to fix the stationary SS net sheet in side. Then bush was made on lathe machine to connect the moveable disk by using grub screw. Then mild steel angles cut by using cutter and it is welded to prepare a base frame. The A.C. motor is attached to the gear box and the gear box is attached to the movable SS disk with the help of shaft to decrease the speed of movable disk and to increase the torque attached with supporting M.S. strips and motor is fixed at lower side of machine because the vibration is reduced at floor level and the machine works properly without vibration. In this machine cylinder is attached and to this cylinder one door is fixed to remove the final peeled product and at the bottom of cylinder waste outlet is connected to remove waste water.

Material specification :**Table A : Prototype specifications of material for peeling machine**

Sr. No.	Name of material	Specifications	
1.	Switch	Type: ON / OFF switch Load current: 10 A	
2.	Pulley and belt	Pulley (1) Diameter: 5 inch Type: A-belt	Pulley (2) Diameter: 1 inch Type: A
3.	Gear box	Type : worm reducer Ratio: 15/1	
4.	Round plate	Material: Stainless steel Diameter: 300 mm Thickness: 5 mm	
5.	Round bar	Round bar (1) Material: Mild steel Size: 20 mm x 200 mm	Round bar (2) Material: Mild steel Size: 20 mm x 100 mm
6.	Bearing	Type: UCFL 204 Square pedestal	
7.	Tank (cylinder)	Material: Mild steel Size: 310 mm Thickness: 5 mm	
8.	SS net sheet	Material: Stainless steel Size : 200 mm x 2 mm	
9.	Speed regulator	Wattage: 200 watt	
10.	Nylon bush	Material: Nylon Size: 16 mm x 25 mm	
11.	A C motor	Volts: 220/230 Power: 1/12 hp Speed: 9500 rpm	
12.	Grub screw and nut bolt	Material: Stainless steel	

**Fig. A : Schematic, a Front side of peeler, b Side sketch of peeler and c Front view actual machine****RESULTS AND DISCUSSION**

The results obtained from the present investigation as well as relevant discussion have been summarized

under following heads :

Performance evaluation of developed ginger, potato and sweet potato peeler comparison with hand peeling:

Complete fabrication of peeling machine is used by different materials and time needed to evaluate its performance. Performance evaluation is one type of measure to find out the drawbacks of developed machine (peeler) and also finalize the ultimate use of machine. It is necessary to evaluate its efficiency, capacity and operational time with different RPM (Jayashree and Visvanathan, 2014 and 2017; Balami *et al.*, 2016 and Oriaku *et al.*, 2014).

The mechanical peeling performance evaluation I have calculated in RPM as well as 80 rpm, 100 rpm, 120 rpm but also manual peeling performance evaluation

calculated (Table 1) 6.35 min, 6.05 min, 4.21 min and 42.08, respectively time. In this project different RPM and manual peeling gives difference weight are 0.180 - 0.188 kg and 0.324, respectively show in Fig. 1 (Balakrishnan, 2005).

Potato don't have particular size and shape but is in spherical shape and it requires different peeling time because the small or large size and shape. In which manual peeling take more time than other mechanical peeling as show in Table 2. The mechanical peeling performance evaluation is calculated on the basis of RPM as well as 80 rpm, 100 rpm, 120 rpm but also manual peeling performance evaluation calculated (Table 2) 5.54 min, 4.51 min, 3.16 min and 16.39 min respectively time. In this project different RPM and manual peeling gives different weight of sweet potato, 0.086 - 0.094 kg and 0.309 kg, respectively show in Fig. 2 (Grewal and

Table 1 : Performance evaluation of developed peeler for ginger (average)					
Simple	Disk speed (RPM)	Wt. of feed sample (kg)	Final product (kg)	Time (min)	Difference (kg)
Ginger	80	2.017	1.822	6.35	0.18
	100	2.015	1.827	6.05	0.188
	120	2.018	1.83	4.21	0.188
	Manual	2.009	1.685	42.08	0.324

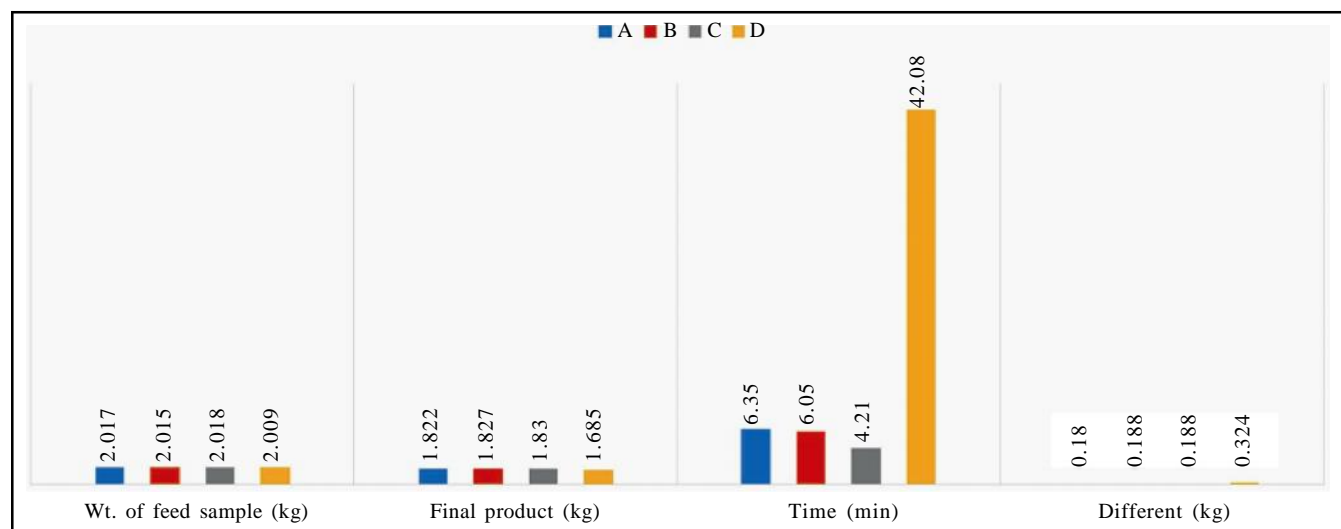


Fig. 1 : Performance evaluation of developed peeler for ginger in which A] 80 rpm, B] 100 rpm, C] 120 rpm, D] hand peeling

Table 2 : Performance evaluation of developed peeler for potato (average)					
Sample	Disk speed (RPM)	Wt. of feed sample (kg)	Final product (kg)	Time (min)	Difference (kg)
Potato	80	2.017	1.931	5.54	0.086
	100	2.023	1.946	4.51	0.09
	120	2.028	1.933	3.16	0.094
	Manual	2.009	1.7	16.39	0.309

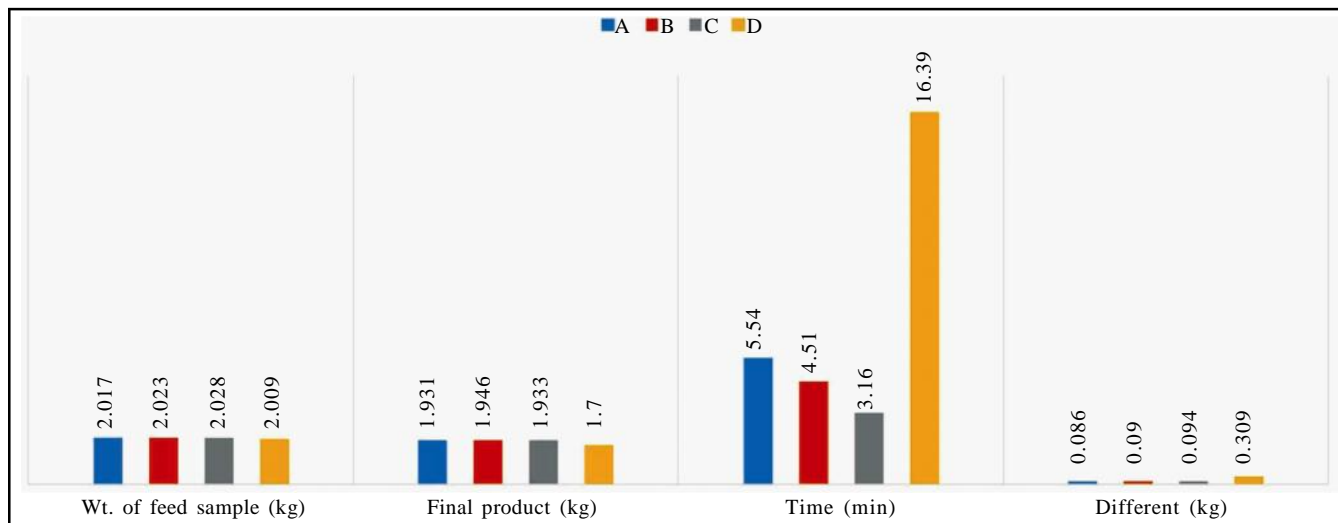


Fig. 2 : Performance evaluation of developed peeler for potato in which A] 80 rpm, B] 100 rpm, C] 120 rpm, D] hand peeling

Sample	Disk speed (RPM)	Wt. of feed sample (kg)	Final product (kg)	Time (min)	Difference (kg)
Sweet potato	80	2.024	1.823	5.41	0.191
	100	2.026	1.822	4.28	0.204
	120	2.023	1.827	3.21	0.196
	Manual	2.016	1.699	14.52	0.315

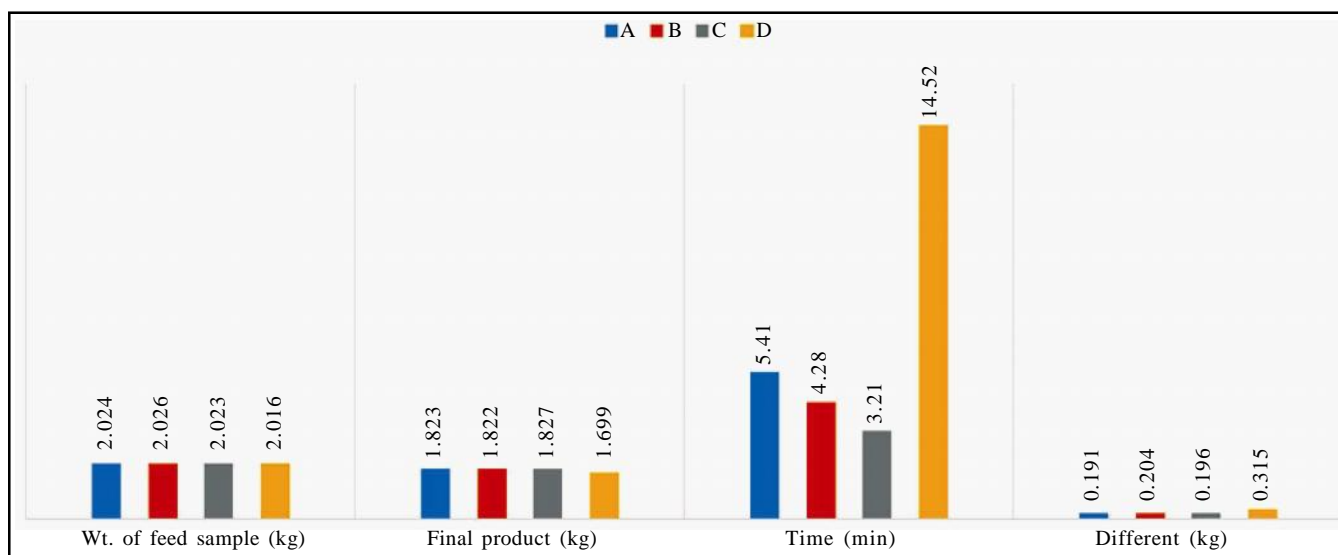


Fig. 3 : Performance evaluation of developed peeler for sweet potato in which A] 80 rpm, B] 100 rpm, C] 120 rpm, D] hand peeling

Jaiswal, 1990).

Sweet potato has a potato shape and size so it requires different peeling time as like potato. In which manual peeling take the more time than other peeling shown in Table 3. The mechanical peeling performance

evaluation calculated on the basis of RPM as well as 80 rpm, 100 rpm, 120 rpm but also manual peeling performance evaluation calculated as shown in Table 3 include 5.41 min, 4.28 min, 3.21 min and 14.52 time, receptively. In this project we have taken different RPM

and manual peeling difference between initial and final weight of sweet potato is 0.180 - 0.188 kg and 0.324, respectively show in Fig. 3.

Conclusion :

Mechanical peeling is better than manual peeling because this peeling was taken more time, damaging final product and cost was also more. In this project Compact peeler thus occupies very little space. Body is of stainless steel with cast iron ring stand for better vibration absorb.

This machine was developed to peel the maximum 5 kg ginger, potato and sweet potato for small scale or house hold purposes. But it give more efficiency of 2 to 3 kg. This machine requires 3 to 4 min for the peeling of 2 to 3 kg of martial depend on material. I observer manual peeling more time take for ginger, potato and sweet potato as 42.08 min, 16.39 min and 14.62 min, respectively but machine reduce time as performing on 120 rpm as par 4.21 min, 3.16 min and 3.21 min.

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