

Fabrication of Root Vegetable Washer

Ganesh M R^[1], Akhil V B^[2], Hareesh V P^[2], Harish M U^[2], Mallikarjun C G^[2]

¹Assistant Professor, Department of Mechanical Engineering, Alva's Institute of Engineering and Technology, Moodbidre, Dakshina Kannada-574225, Karnataka.

²U.G. Students, Department of Mechanical Engineering, Alva's Institute of Engineering and Technology, Moodbidre, Dakshina Kannada-574225, Karnataka.

ABSTRACT:- Adequately cleaning is a critical operation in the production and distribution of fresh produce. Root vegetables like carrot, radish, ginger etc. need to be pre cleaned before transporting from field to market. At present there is no primary processing equipment like vegetable washers available for small farmers. In an attempt to improve upon the traditional cleaning methods of root crop vegetables, it has expressed a need for an innovative processing approach to the cleaning of their harvested organic produce to meet their special needs. A batch type, small vegetable washer with holding capacity few kg was developed for washing root vegetables like carrot and ginger. The Automatic Root Crop Washer is a machine which could find its use in the agricultural fields. The root crops like potatoes, carrots, radish, etc., after harvesting have to be cleaned off the soil and clay particles before transporting them from field to market. Normally the farmers of Punjab (INDIA) follow a traditional method of cleaning the carrots, radish in which the roots are washed manually by hands and feet. Therefore our project was based on giving the best solution to this problem.

Key words: Barrel Washer, Root Crops, Pedal Operation, 0.5hp Motor

1: INTRODUCTION

Washing is one of the primary unit operations for value addition of horticultural produce at farm level. Washers may be continuous or batch type. Batch type washers are recommended for small plants where use is intermittent and operating costs are not critical. Soaking in still or moving water is effective only if dirt or other surface undesirable is present in small quantities and is loosely attached to the product. Water sprays vary from low pressure wide angle to very high pressure directed jets and are very effective since they physically remove firmly attached pieces of dirt and agitate the mass of product, particularly if it is carried in a water bath.

Flood washing is done by a large quantity of water moving at a moderate to high speed over the product. Vegetables are washed in fields using a water jet delivered from a hosepipe and immersion soaking. These methods demand more labour but washing efficiency is very low due to non-removal of thin layer of surface mud coating. So there is a need for and efficient washer to remove the mud and other foreign matter present on the surface of the vegetables, more specifically for root crops.

Vegetables are washed thoroughly to remove particles of soil and microorganisms that are present in soil. Vegetables may be contaminated with *Escherichia coli* and hence they should be lifted from water rather than water poured or drained off, in which case soil remains in the container with the vegetable.

Root vegetables like carrot, radish grow on heavy soils which are more rough and coarse. As the above vegetables grow under the soil they are well prone to mud and dust. These crops are manually harvested with leaves at the top to minimize damage while handling. They can easily be contaminated with microbial actions, physical damage, cracking cuts, bruising etc. They cannot be stored along with soil for a long time. It is necessary to wash off the mud and dirt particles which would reduce the physical appeal in the market and also aid in further processing.

Relatively little information is available in the research literature on mechanical root vegetable washers for small farmers. Conventional washing methods for carrots, consisting of rotary washing systems in which carrots are not immersed, tend to damage carrots. Washing of vegetables by means of washer spray is the most satisfactory method. A product that is heavily contaminated with soil should be thoroughly soaked in water to loosen the soil before passing it under sprays. In the present system at the study area, the method of washing root vegetables are by trampling under feet in running water like streams and also in washing yards. This not only damages the product but also results in contamination because it is constantly rubbed with the feet. The operation requires more labour and the labourers are constantly exposed to chill water during the washing operation. There is no primary processing equipment like washers for these root crops adopted by farmers in this region. The primary motive of this study was to develop a small capacity root vegetable washer suitable for small farmers with improved quality, time and labour savings.

2: LITERATURE SURVEY

Root vegetables are vegetables grown underground. There are starchy root vegetables which form an important part of a main meal and are often eaten on a daily basis - for example tubers, and in particular the ordinary potato which is one of the world's most popular root vegetables. Root vegetables usually form a very substantial part of a meal as they are often heavy and filling - particularly nutritious and healthy! Root vegetables are sometimes known as favourite, traditional winter vegetables or spring vegetables, as these are the seasons in which many are grown and ready to eat.

2.1 Cleaning of Root Vegetable by Feet & Hand: Farmers wash and clean freshly harvested carrots with their Feet and Hand. But in the farm it's not easy clean huge amount of vegetables using hands. When we conducted the survey by interviewing the farmers most of the farmers have told that it's one of time consuming and costly method as it requires more labours or workers and workers will get stressed. To clean the vegetables there should be more amount of water source is required.

2.2 Cleaning of Root Vegetable in Pond: The harvested vegetables are carried from farm to the pond using any transportation depend on the amount of the product is harvested in the farm. When the harvested vegetable is transported to pond before that the pond is filled with full of water and then the vegetables are poured into the pond using some cleaning equipment like any wooden stick which is attached with rough cotton material. But this process required more time and the workers also more number required.



Fig 2.1 Cleaning of Root Vegetables

3: OBJECTIVE OF PROJECT

Normally root vegetables are cleaned before sending it to market. In the farm it's not easy clean huge amount of vegetables using hands. Therefore in order to overcome to reduce the time and effort of the workers the washer is required. In which the barrel type of washer is developed.

This machine will reduces time, effort of the formers and it is more efficient than other methods. Also wastage of vegetables can be prevented, this machine is very simple to operate and fabrication cost also less. Therefore the overall efficiency of the machine is high comparing any other normal manual process.

4: COMPONENTS USED

1. **DRUM:** - Drum is a length of 125cm and diameter of 65cm. It carries capacity of load 10-15kg. And it is made up of a mild steel sheet metal which is having tiny holes on their body.
2. **FRAME:** - The frame is made up of mild steel 2 inch square pipe. Which has a length 191cm & width 68cm & height 120cm for the purpose of strength we used 16 gauge.
3. **MOTOR:** - The motor used is 3 phases of 0.5 HP induction motor which is having a speed of 1370rpm. The max power up to 0.37 KW can be generated from the motor.
4. **SHAFT:** - The shaft is made up of mild steel. This has diameter of 2.5cm. Two shafts are used for rotating the drum. One is of having a length of 195cm, & another one 135cm
5. **BEARINGS:** - The bearings used for holding the shaft are P205. This is having diameter of 2.5cm. & the no of bearings are used are 5. The load carrying capacity is 14KN
6. **BUSH:** - The fibres bushes are used of diameter 8.5cm. These are coupled to the shaft for the purpose of reducing the wear of shaft and generation of friction and noise. The main purpose is for smooth operation.

- 7. CRANK & PEDAL:** - The crank and pedal arrangement are used to drive the system manually by cycling operation. The pedal is used to run the machine
- 8. SPROCKET & CHAIN:** - There is different diameter of sprockets are used. In which there are 3 smaller (7.5cm) & one (20cm) larger to transfer the motion from one shaft to another shaft.
- 9. PULLEY:** - The electric motor and shaft pulley serves as means which the belt transmits the power from the electric motor to the shaft. The diameter and shaft pulley are 30cm and 3cm respectively.
- 10. BELT:** - Single belt used between electric motor and pulley. Belt used to transmit the power from motor to shaft. The type of belt used is B38
- 11. NUT & BOLTS:** - Much number of nut & bolt are used in machine. The materials of these components are mild steel.

5: WORKING PRINCIPLE

The components used for machine is listed above and fig is shown below. The mesh barrel is powered by manually and a motor to provide the necessary torque and speed requirements to facilitate the wash cycle. The operating speed of washing is comparatively low. Slower speeds tended to make it difficult for the unit to start and keep rotating, while faster speeds were not used to avoid root vegetables breakage. The washer removed soil and foreign material sufficiently during the washing operation. The system could accommodate samples up to 10-15 kg. The water requirement per batch is min. An operator needs to be present for sample loading, unloading and for operation of the washer using pedal or motor.

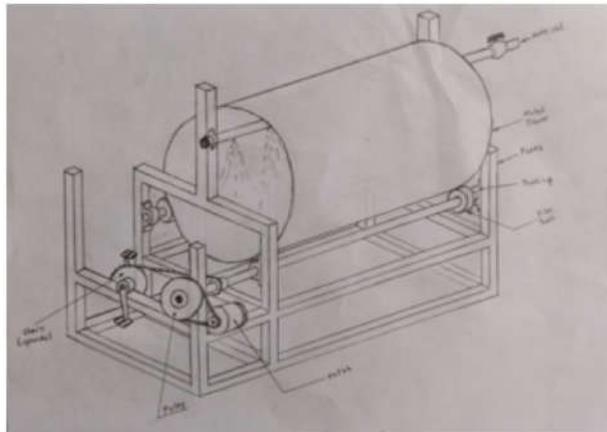


Fig 4.1 Design of Barrel Type Washer



Fig 4.2 Fabricated Barrel Type Washer

6: RESULTS AND DISCUSSION

The overall performance of the device was determined by measuring the different parameters considered in the study. The washing capacity, cleaning efficiency, and skinning damage of the device as affected by speed of the washing cylinder and loading weight were computed and analyzed.

5.1 Cleaning Efficiency: - Comparison of means (Table 1) showed that the best combination to achieve the highest cleaning efficiency is operating the machine at 25-30 rpm with 10 kg loading weight. The cleaning efficiency dramatically decreases with the increase of loading weight. This is because the greater the amount of potatoes inside the cylinder the lesser time the surface area of the tubers were exposed to water.

5.1 Skinning Damage: - Based from the results of comparison among means (Table 1), The combination of 20 kg loading weight and 25-30 rpm speed of operation achieved the lowest skinning damage 3.79%. The higher weight of the root crops with min speed will gives the min skinning damage.

Table1. Performance of the Device as affected by speed of the cylinder and loading weight

Loading weight, kg	Cylinder Speed, rpm	Cleaning Efficiency, %	Skinning Damage, %
10	25-30	93.11	7.86
15	25-30	90.26	5.23
20	25-30	86.21	3.79

7: ADVANTAGES

- This method used to reduce time taken to clean the root vegetables.
- By this machine we can clean vegetables up to 10-15 Kg at a time.
- Machine is easy to assemble and disassemble.
- Effort of the farmers is reduced by this machine.
- Single worker is enough to operate the machine.
- Wastage and damage of vegetables can be reduced
- Efficiency of machine is more compared to manual methods.
- In this machine the usage of water also min and it can recycled.
- The machine maintenance and the cost of the machine are low.

8: CONCLUSION

Root Crop Washer proved to be more efficient than the traditional approach used saving the cost of the labour and time. The capacity, efficiency and performance index of machine varied with respect to speed of rotor, depth of water and quantity of material to be washed. The developed manually operated root vegetable washer was of 10 kg holding capacity and it was found suitable for washing root crops like carrot and potato. The washer was evaluated in the farmer's field.

Performance trials revealed that gave better performance in terms of washing and cleaning efficiencies. The automated washing process reduces the current number of workers to one which allows other workers to carry out other farm duties. The compact design of the barrel washer will fit in the space allocated by the worker.

9: RECOMMENDATIONS

A recirculation water tank was proposed as a resource saving feature. However, due to lack of knowledge in filtering the dirt in the recycled water and maintaining water cleanliness to meet Canadian regulations. For future retrofits, implementing a water recirculation tank can save water consumption and enhance sustainability awareness. The ideal material for the barrel shell would be stainless steel. Replacing the carbon steel barrel with a stainless steel barrel can reduce maintenance of repainting the barrel to cover paint chips and it would meet food handling standards. Although most components of the drive-train are stainless for corrosion resistant, introducing an enclosure for the drive train can prevent all components from exposure to the environment and for safety of the user by isolating moving parts. The use of water proof belt for the conveyor belt is strongly recommended as this will not absorb moisture as well as reducing the load on the conveyor belt.

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