

# An Overview on Mechatronic Application and Effectiveness of Developed Stand Alone Dioscorine Removal System

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**Abstract** This study which is entitled as the Effectiveness of Stand Alone Dioscorine Removal Machine will focus toward the removal the dioscorine in the *Dioscorea hispida*. *Dioscorea hispida* is also known as 'ubi gadong' is a large tuber, underground tubers that have fibrous root, the tuber are produced near the soil surface and are extremely poisonous, alkaloid that is dioscorine. This machine has been improved to increase the effectiveness to get a better result during operation. The tubers were cut into into small pieces before wash by flowing water using the machine, the circulation of water play important role in the operation. The tuber maybe easily rub each other during water circulation and make the dioscorine more faster to move out from tuber. It also has many advantage such as can retain in a big capacity, high efficiency, used of water can be saving, the machine can work continuously, easy and simple to operate, friendly used and with long life. As a result for this study, the measurement on efficiency of this machine because it can be commercialized for dioscorine removal and can be used easily by followed the instruction. This machine is very effective in terms of removing dioscorine from tuber as well as to be used at farmers level or commercial purposes.

**Keywords:** mechatronic, microcontroller and sensor, stand alone machine, farm mechanization, machine effectiveness

## 1. Introduction

The twining vine, arising from tuberous roots, and reaching a length of several meters. Stems covered with few or many short, sharp spines. Fruit is a capsule, oblong and about 5cm long. Flesh and sap of tubers are yellowish. As we know, *Dioscorea hispida* is a poisonous plant, the tuber of this plant contains toxic poison and it only can be consume and eat after the dioscorine is removing.

This Stand Alone Dioscorine Removal Machine is used to replace and reduce the human work in the production, operating by circulation of water and fully automated. The automation system is used to control the system operation during wash the tuber. The light sensor and ultrasonic sensor is including detecting the intensity and water level. Light sensor is detecting the intensity of water; it can read the light intensity in a room and measure the intensity of cloudy surface. Ultrasonic sensor also used to detect the water level in the machine, once the water is achieve the distance that have been set up, this sensor can measure the distance in centimeters and inches. The principle of this sensor is, it measure the distance by calculating the time it takes for a sound wave. The main component is NXT Intelligent Brick, this component is used to take the input from sensor and control up. Timer controller is important

to make sure the suitable timer for water remove and renew. The time and the water level are set up in that component for fully automated of machine operation.

For the introduction of this study, the stand alone removal machine allow to remove the dioscorine by water circulation according on certain time on continuously circulate the water by using the water pump. A water pump is used to move fluid by mechanical action, pump operate in some mechanism such as rotary and used energy source like electricity to perform mechanical work that can make the fluid is moving. A solenoid valves are used to control water inlet and water outlet, it can be on (open) and off (closed) automatically for control input and output signal from the sensor. A solenoid valve is an electromechanically operated valve that controlled by an electric current through a solenoid. Valves mechanically open and closed when receive mechanical energy that has convert from an electrical energy.

After run the machine, the water quality of dioscorine waste is measure by using water quality checker to make sure the poison is out and to measure the effectiveness. Parameter measurement commonly made for water quality is temperature, pH, conductivity and dissolved oxygen. Water quality is referring to the biological characteristic, physical and chemical properties. In waste water contain total solid may refer to matter total suspended solid, materials which are not dissolved in water that cannot

filterable and total dissolved solid, materials that are completely dissolved in water. We use natural tap water as a control to measure the water quality of *Dioscorea hispida* waste. The water is measure every 20 minute until the waste water equal or near to control water.

We, first time, develop a machine that can be used for removing discorine as well as saving time for the process. We are trying to commercialize this machine to the farmers so that they easily remove discorine and save time. Discorine is poison that can disturbance and harmful to consumers, so, with his machine, we can the tuber is edible to consume. Traditional way is usually we soaked the tuber in the sea or the river that have water flow for few days but with this machine can reduce time of operation and worker cost if compare to traditional way. Such objective of study are;

- i. To develop the instruction standard of procedure discorine removal machine
- ii. To test the stand alone discorine removal machine
- iii. To measure the efficiency of machine by using water quality checker

By the presence of stand-alone removal machine, students in the future will be known better how to remove the discorine with efficient in a short time, it also can reduce cost of hired worker. With it specification, it can easily be used by student or other people for commercial product of *Dioscorea hispida*.

The containers are made from special material and can prevent water leaking. This machine used advance technology designs, which greatly which extend container, strainer and water pump life, it can reduce maintenance frequency and mechanical life can be longer for many years. During the process of cleaning and discorin removal, the breakage rate is almost zero; the tuber can be maintained in good condition. During washing and cleaning process, the water circulation principle and revolution can increase the touching frequency of the tuber. It can make tuber will rub each other, continue with water flow and easily to reduce the discorin contain in short time.

Besides, there is no attractive study material for removal machine that was publishing in the internet or web site especially about the discorine removal. So, with this machine it can be used for this study is an alternative for this matter. This machine will be useful for student to know better about the way to remove the discorin and how to use this machine. The existence of this machine will be more helpful to the all student in Agriculture field when the machine is published. So, the information about the stand alone removal machine will be display, the students and peoples can get the information about that.

## 2. Literature Review

### 2.1. Washing Machine

Prior to processing the fruits and vegetables are washed and rinsed by means of flumes, soak tanks, water sprays, flotation chambers, or any combination of these methods. Great quantities of water are used. Detergents and ultrasonic techniques are also being tested for increased cleaning efficiency. Blanching is accomplished by putting the products in contact with water or steam. In almost all

cases for preparation of vegetables to be frozen, it is imperative that the blancher processes be terminated quickly. Consequently, some type of cooling treatment is used. Typically, if the product has been water blanched, the vegetable is passed over a dewatering screen and cooled either by cold water flumes or cold water sprays. Product to be canned is usually not cooled after blanching. The pollution loads from blanching are a significant portion of the total pollution load in the effluent stream during the processing of certain vegetables.

The system of washing represented in the product brushed and displaced by the moving brush until arriving to dryer sheet. The discharged out, so the foreign materials are removed from the surface of the product or dissolving in discharged water. The water discharged after washing through the filter that removes the suspended materials from the water. The cleaned water pumped to the washing machine outlets. The turbidity measuring device used is Japan Model. HORIBA with High sensitive turbidity sensor ranged between 0 and 1,000 NTUs (Nephelometric Turbidity Units) was used to check water quality [1].

The process of potato washing on vibrating devices of continuous action, develop and produced at the department of equipment of working chamber. The reblanching vibro – stimulator with automatics regulator is used as an actuator. High speeds shooting that make the tuber moved circulatory. With the increasing the vibration intensity, the tuber adhesion decrease and they begin to loose the contact with the vibrating working chamber, potato loosening and intensive circulation take place, it favor qualitative washing. The speed of tubers movement in the washer was determined by means of measurement of time during which the marked tubers passed the working chamber [2].

### 2.2. Sensor

Optical sensors are designed in many ways to detect light scattering and attenuation in order to measure sediment and turbidity in water samples. A water sample, the red-shaded region, is illuminated by a light source, shown by the red light bulb, and one or more photo detectors convert the light radiated from the sample to photo current. The amount of photo current depends mainly on the area of the illuminated particles but also on particle size, shape and reflectivity. Since the area of the illuminated particles is directly proportional to the suspended solids concentration, measurements of light scattering provide a way to estimate. Certain conditions (size, color, disaggregation effects), explained in related application notes, must be met to do this accurately. Allah Subhanawatala created light which is not actually came from the sun but arrive from the khudrat of Allah [3].

### 2.3. Turbidity

Instantaneous water quality measurements include any measurements taken by field instruments, such as single- or multi-parameter probes. Data are recorded on a field sheet, discharge measurement sheet, or habitat assessment sheet. In-situ water quality parameters may include water temperature, pH, dissolved oxygen, specific conductivity, turbidity and percent oxygen saturation.

Turbidity is an optical property of water that causes light to be scattered and absorbed rather than transmitted

in straight line through the sample. It is caused by the molecules of water itself, dissolved substance, organic and inorganic suspended matter. Devices commonly used to measure turbidity include the Jackson candle turbidimeter, absorptimeters, transmissometers and nephelometers.

All turbidity measurements detect the amount of light either transmitted through or scattered by the particles in a sample of water. Over the past several decades, instrument technology has advanced dramatically and many turbidity measurement techniques have resulted. These new approaches evolved to address interferences or inconveniences associated with earlier turbidity measurement techniques. Different technological approaches (often using different light sources and detector designs) have been used to compensate for or minimize measurement errors attributed to color, bubbles, stray light, absorption, and path length.

## 2.4. Detoxification

The traditional method used for blanching is peel the tuber skin and slice into small pieces about 2mm per slice. Firstly, the toxic compound in the tuber is removed by using ash absorbance. After that the tuber is soaked in water for a few hours that is 2 hour, 4 hour or 6 hour. The blanching is can reduce the quantity of discorine in tuber, the solution used to soaked the tuber is  $\text{Ca}(\text{OH})_2$  0.3% for 6 hour and after that the discorine content were analyzed [4].

Leaching the poison from the tuber, the tuber were peeled, washed and cut into small pieces kn cubes and also slice into thin chip. One kilogram of these chips were then changed into a leaching column and arranged as a fixed bed. Fresh water was flown into the leaching column at certain flow rate to hydrolyse the poison from the tuber and leach them out. The tuber amples were taken out every 30 minute for HCN equivalent determination [5].

The best accounts of detoxification of *D. hispida* are given by Ochse and van den Brink. One method is to cut the tubers in pieces, cover the surface with wood ashes for 24 hours, and then steep them in seawater for several days. The pieces are then washed with freshwater and dried. The process is repeated several times, and the pieces are not eaten until dogs can eat them without noticeable ill effects. Another technique is to dry the slices first, mixed with ashes. In the Philippines, the producted "nambi" is formed by salting the tuber pieces and then pressing them under water until no whitish sap remains. There are many variations, but in every case the process is long and hard. Coursey summarizes techniques for detoxification of yams. *D. dumetorum* is always soaked in water in one way or another and is often cut up or macerated before soaking. Extraction, at least in the latter case, depends on the solubility of the poison in water [6].

## 3. Methodology

Discorine removal system is a machine that used to remove the discorine with the water. It is a simple machine with two tanks which the upper tank used to hold ubi gadong and water and lower tank consist of water pump. The discorine removal system is depends on the electrical power supplier to function. Discorine removal machine is a machine that included several electronic

components for automation to remove the discorine found in ubi gadong which is toxic. Figure 1 show the algorithm process from developed stand alone machine. Figure 2 shows the overview of standalone machine while Figure 3 shows the Water Quality Checker for determination of effectiveness of standalone machine. The sensors play an important role in manages the input and output source.

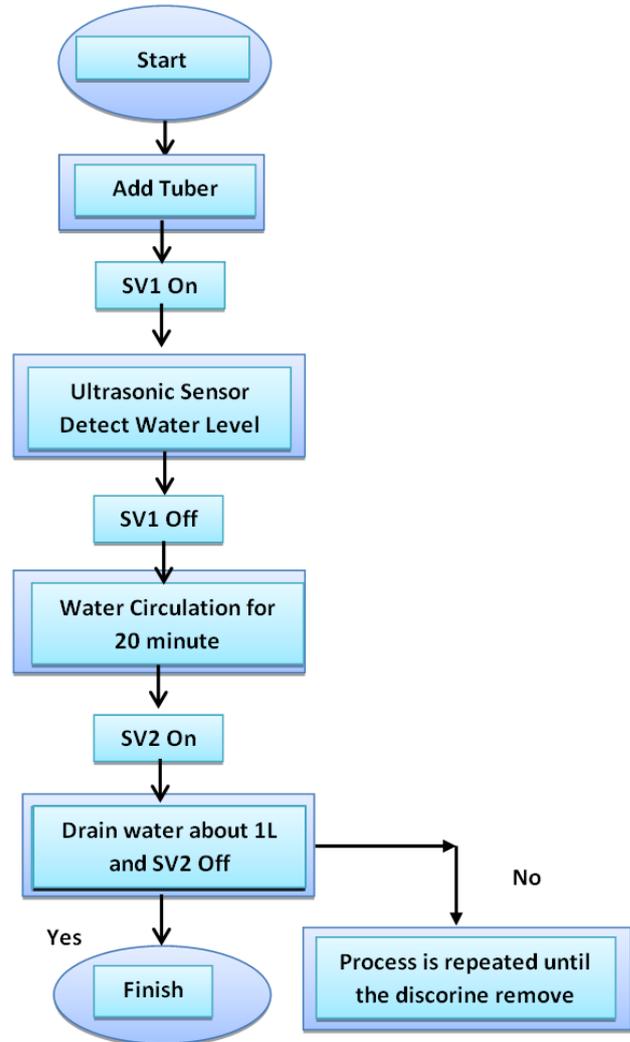


Figure 1. Algorithm process of machine

Controller with timer is also important in manage the timing when water will be renewed and removed. Water pump provides water force which will cause the rotation of water. A few modifications may help improve the machine to operate more efficiently [7].

## 4. Result and Discussion

Two methods have been with or without adding salt. From the graph we can see the result with salt more efficient in comparison. Removal machine is operate by circulate the water and in process water circulation, the alkaloid content in *Dioscorea hispida* decreased with increasing circulation time to some extent. The time is recoded three minutes for one read of intensity. For the first read, the intensity for salt and without salts is same, it about 61 and after that, the different not obvious until 9 minute later as show in Figure 4 (without salt) and Figure 5 (with salt). The intensity is recorded for 1 hour with

circulation water without stopping the machine. The water with salt more cloudy than without salt, that mean the dissolved material is more faster move out from the tuber. For the with salt, the obvious the intensity is at minute 24

until minute 54, the reading is reach about 42. Without salt, the intensity increasing time was not obvious, may be need more time and more new water replace in machine to remove the alkaloid.

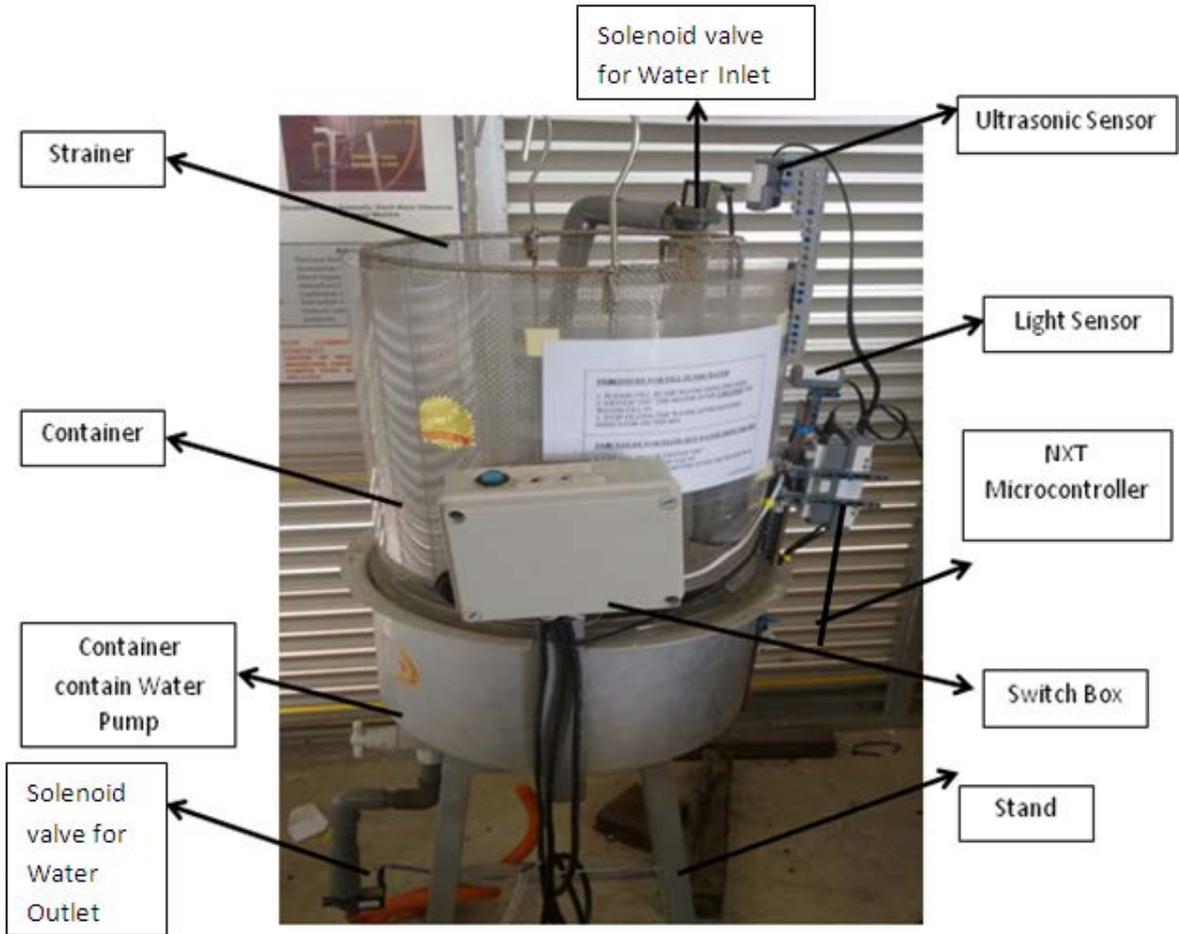


Figure 2. An overview of standalone machine

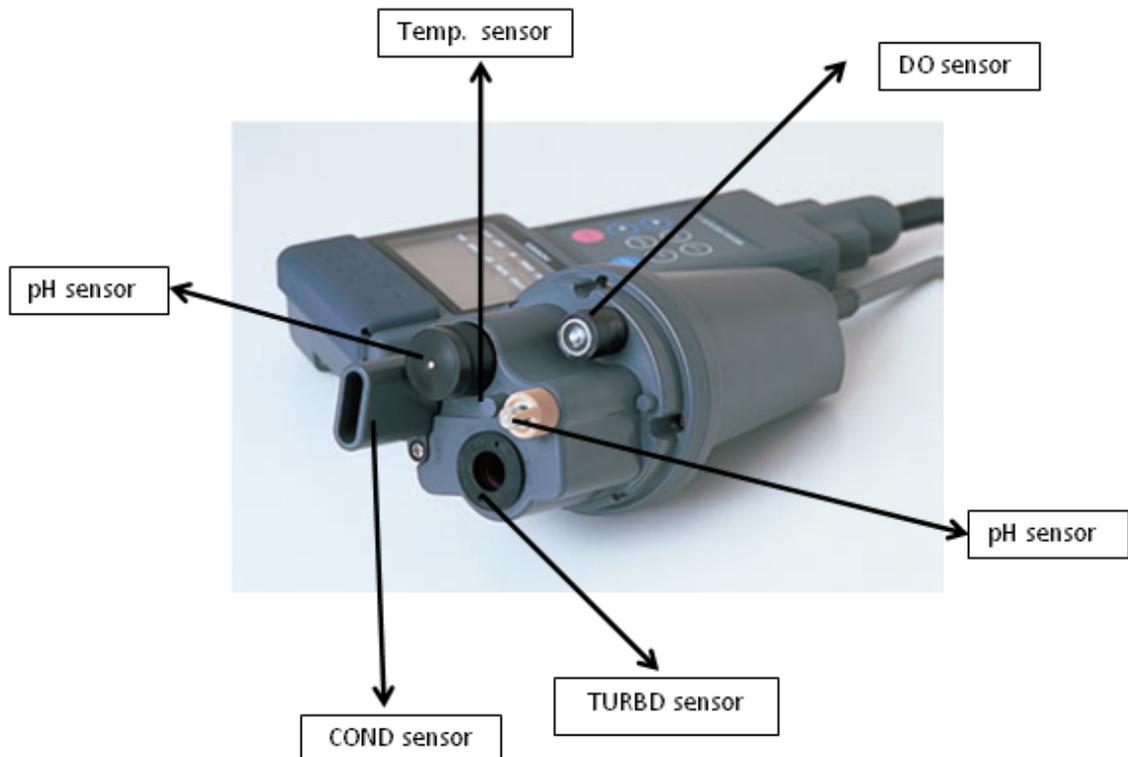


Figure 3. Water Quality Checker used in this study

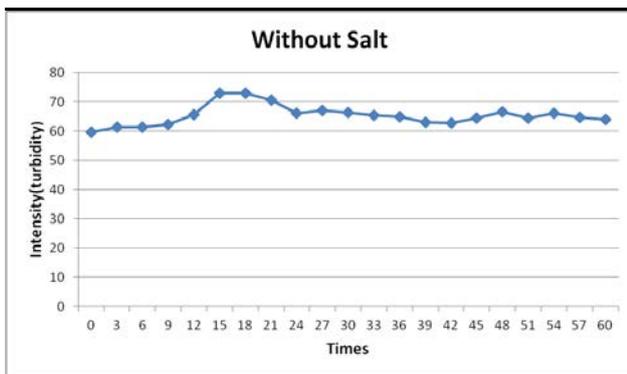


Figure 4. The intensity versus times (without salt)

For 1 hour the machine is working, the quantity of water move out from the machine, contain poisons is about 6 liters, the water is replace with fresh water also same quantity with water move out. The water takes out and replace with fresh water every 10 minute, this process to make sure the alkaloid composition in water is reduce increasing the time.

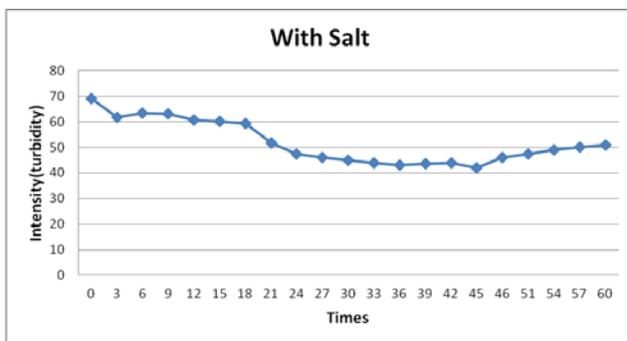


Figure 5. The intensity versus times (with salt)

In this experiment, we use the salt as an indicator for efficient removal, to compare between with or without salt used. As we know, the salts are ionic compound, these occur from the neutralization reaction of base and acid. They are composed of cations and anion that made electrically is neutral. In plant materials generally occur partially as free bases and partially as salts which are insoluble in most of the organic solvents. Like basic compounds they form their crystalline salts alkaloids with acids like hydrochloric acid, sulphuric acid, citric acid and tartaric acid. The free alkaloids are insoluble or slightly soluble in water, but their salts are freely soluble. Therefore, alkaloids are separated from non-polar solvents by salt formation. To compare the experiment with salt and without salt, the result for with salt show more efficient and time need also can be reduce. Figure 6 show the result comparison between both analyses.

For without salt, more water and more time are needed to remove the poison contain in tuber and from this finding, enhancement is made on transforming the manual of existing machine that was developed [7].

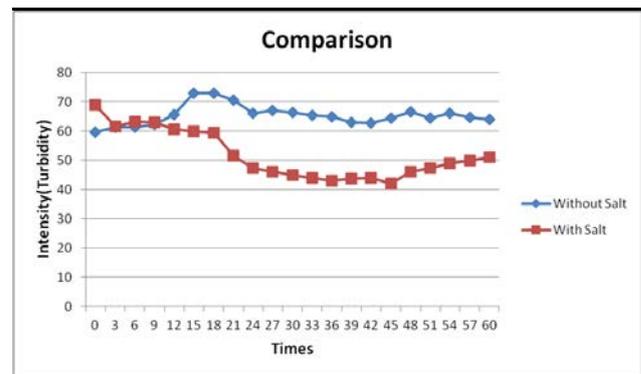


Figure 6. show the result comparison between machine effectiveness measurements

## 5. Discussion

Alhamdulillah, the graphs show the result of turbidity of water by using the light sensor to detect intensity. Turbidity mostly controlled by the amount of suspended material although high concentrations of dissolved material may also affect light penetration. The removal machine is used to remove the toxic; there is alkaloid in *Dioscorea hispida*, the alkaloid need to detoxification for safety before used. The water is added in the machine, also slice tuber and make sure the machine is working and circulate the water; power of pump is used to supply the power. Using this machine the removal of alkaloid more efficient if compare to traditional method, it also can save the operation time and labour cost. Adding salt during process of removing discorine is very effective to make shorter the time and saving energy.

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