Angewandten Biologie Forschung
www.ctbscience
ISSN: 2321-1733
Vol-1: No-3: 2013: 1-8.

Effectiveness analysis of stand-alone toxicity removal system

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Abstract

Dioscorea hispida Dennts tubers are highly toxic and can only be eaten after the elimination of toxins. In the present work an attempt has been done to develop stand alone toxin removal machine which is used to remove (Dioscorine) in the tuber by using modern method. Statistical analysis from the results obtained concluded that the toxic is fully removed from blended tuber after 7 hours of machine operation and water usage is about 60 liters. Hence, This machine can work as stand alone which can replace traditional method for removing toxic content of tubers and and can owned at home for daily traditional food processing.

Keywords: *Dioscorea hispida,* Dioscorine, *Cyprinus carpio,* survival rate, Agriculture Mechanization

Cite this article as
Mohd Hudzari Hj Razali, Muhammad Rizuwan Yahaya, Nashriyah Mat, Wan Musa Wan Muda, Abd Jamil Zakaria, Nurul Syuhada Mohamad. Effectiveness analysis of stand alone toxicity removal system. Angewandten Biologie Forschung. 2013; (3): 1-8.

1.0 Introduction

Dioscorea hispida which is also known as 'ubi gadong' has a large underground tubers that have fibrous roots. The tubers are produced near the soil surface and are extremely poisonous, due to alkaloid that is known as Dioscorine. It has twining vine, arising from tuberous roots, and reach a length of several meters. Stems are covered with few or many short, sharp spines. Fruit is a capsule, oblong and about 5 cm 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 can only be consumed only after the toxin is removed [1] . As the process of removal of toxin from tubers is tiresome and laborious, various attempts are made for automation of toxic removal process. Even though, many literature reports are available for toxic removal process, very few or no literature is available for removal of toxin from tubers of *Dioscorea hispida*. Hence, in the present work an attempt has been done to design and test a novel Stand Alone Toxic Removal system. In the proposed machine, light sensor and ultrasonic sensor were included in detecting the intensity and the water level. Light sensor is used for detecting the intensity of water; it can read the light intensity in a room and measure the intensity of cloudy surface. Ultrasonic sensor is used to detect the water level in the machine, once the level of water is achieved at the distance that have been set up, this sensor can measure the distance in centimeters. The principle of this sensor is, it measure the distance by calculating the time it takes for a sound wave. The main component in the designed machine is NXT Intelligent Brick microcontroller, this component is used to take the input from sensor and control the working of machine. Timer controller which is used is important to make sure the suitable timer for water removal and renewal. The time and the water level are set up in that component for fully automated machine operation [2]. In the proposed machine, removal of the toxin by water is achieved by circulation of water continuously by using the water pump. A water pump is used to move fluid by mechanical action, pump operates in some mechanisms such as rotary and used. After running the machine, the water qualities of toxin waste were measured by using the water quality checker to measure its effectiveness. Water quality is referring to the biological characteristic, physical and chemical properties. Physical parameters commonly measured water quality is temperature, pH, conductivity and dissolved oxygen. We used natural tap water as a control to compare with the water quality of *Dioscorea hispida* waste water. To check the effect of waste water on living organisms, waste water was exposed to *Cyprinus carpio* fish, to know the survival result of that fish after the toxin is removing [3-6].

2.0 Material and methods

Tubers of *Dioscorea hispida* were cut into small pieces and soaked in the water that contains salt and tangerine for one night. All soaked tubers were placed in the blender and little bit of water was added for easier blending until crushed finely. Clean water was filled in the plastic container (about ¾ full) and the machine was switch. Blended tubers were placed in the machine and clean cloth was placed in the filter to avoid the spillage of tuber. Machine was switched on for circulating the water and the machine was run for 7 hours nonstop. The sample of waste water (1 litre) was taken every 20 minute for testing and about 21 samples were taken. The waste water was measured for pH, conductivity(ms/cm), turbidity, dissolve oxygen(mg/L), temperature(°C), salinity (%), intensity and Survival Rate. Life fish test was performed to measure the survival rate of fish in waste water. If fish survived for more than

6 hour, it indicates the non-toxic nature of water. The maximum time for the fish survive is set up for 6 hours. The whole series of steps which were carried out is shown in the following pictures.

Figure-1: *Dioscorea hispida* tuber slices

Figure-2: Tuber of *Dioscorea hispida* were blended using commercial blender

Figure-3: Water was filled in the Stand Alone Toxin Removal Machine

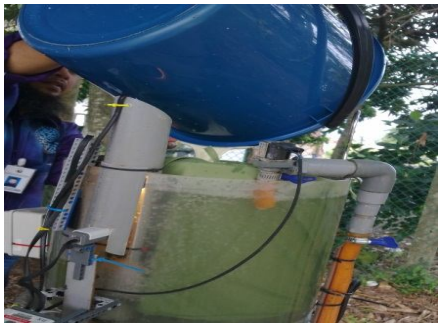


Figure-4: Finely crushed tuber were filled into the machine

Figure-5: Water is circulated continuously in the machine

Figure- 6: Waste water is collected at constant intervals

Figure-7: Toxicity of thus collected water is tested by measuring survival time of fish

3.0 Results and discussion

In the present work, the machine which is designed for removal of toxin from tubers is run for 7 hours to remove the toxin in about 60 liters. To compare the parameter of waste water from the tuber, clean water that is tap water is used as a control. The parameter use are pH, conductivity(ms/cm), turbidity, dissolve oxygen(mg/L), temperature(°C), salinity (%), intensity and survival Rate. Control, exhibited the pH value of 5.3, conductivity is 0.6 ms/cm, turbidity is 18, dissolved oxygen is 0 mg/L, temperature is 27°C, salinity is 0%, intensity is 53 and survival rate for fish is 360 minute. The waste water which is withdrawn until 420 minute (7

hours) was also tested for various parameters and the results are shown in Table-1.

For the first waste water at 1 liter (minute of 20) the various parameter values are pH value is 3.8, conductivity is 7.2 ms/cm, turbidity is 18, dissolved oxygen is -0.1 mg/L, temperature is 27°C, salinity is 0.4%, intensity 58 and survival rate for fish is only 24 minute, after that the fishes started dying. At minute 280, that is at the waste water 40 liter, the fish start survived and the various parameter values are pH is about 4.0, conductivity is 4.1 ms/cm, turbidity is 20, dissolved oxygen is 0 mg/L, temperature is 27°C, salinity is 0.2%, intensity is 48 and the survival rate is 360 minute.

Cyprinus carpio, naturally live in temperate climates in fresh or slightly brackish water with a pH of 6.5–9.0 and salinity up to about 0.5% and temperatures of 30 to 35°C. The ideal temperature is 23 to 30°C, with spawning beginning at 17–18°C; they easily survive in winter in a frozen-over pond, as long as some free water remains below the ice. *Cyprinus carpio* weree able to tolerate water with very low oxygen levels, by gulping air at the surface (Freyhof *et al.,)*. After the machine was run for 7 hours, various parameters which were recorded exhibited same value of waste water and control water (tap water).

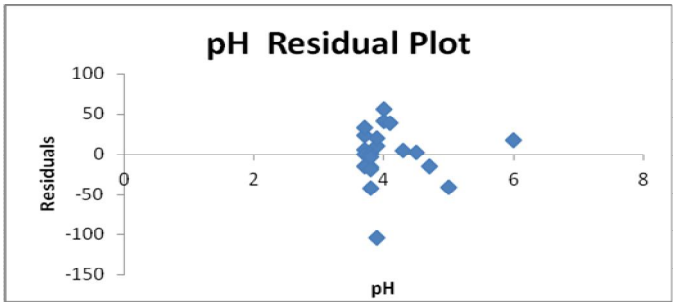
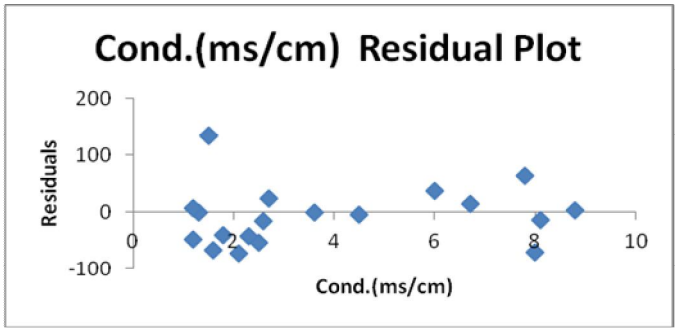


Figure-8: Graph of pH residual plot

Figure-9: Graph of Conductivity residual plot



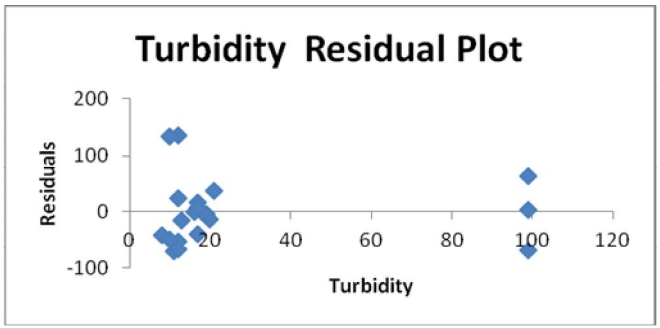


Figure 10: Graph of turbidity residual plot

Running time: 7 HOURS
Control :Waste water

No.	Time (mint)	Liter	pH	Cond. (ms/cm)	Turbidity	Do (mg/L)	Temp (°C)	Salinity (%)	Intensity	Survival Rate
1	20	1	3.8	7.2	18	-0.1	27	0.4	58	24
2	40	4	3.8	7.7	18	-0.1	27	0.4	56	25
3	60	7	3.7	8.5	18	-0.1	27	0.5	50	23
4	80	10	3.7	8.6	99	-0.1	27	0.5	52	37
5	100	13	3.7	8.5	99	-0.1	27	0.5	47	25
6	120	16	3.7	8.4	99	-0.1	27	0.5	46	24
7	140	19	3.7	8.4	99	-0.1	27	0.4	42	24
8	160	22	3.8	7.2	99	-0.1	27	0.4	0	32
9	180	25	3.8	6.5	99	-0.1	27	0.3	0	55
10	200	28	3.8	5.9	99	-0.1	27	0.3	0	80
11	220	31	3.9	5.5	99	-0.1	27	0.3	0	110
12	240	34	3.9	5.0	99	-0.1	27	0.3	48	140
13	260	37	3.9	4.6	99	0	27	0.2	51	160
14	280	40	4.0	4.1	20	0	27	0.2	48	360
15	300	43	4.0	3.8	19	0	27	0.2	47	360
16	320	46	4.1	3.3	99	0	27	0.2	45	360
17	340	49	4.3	2.2	17	0	27	0.1	50	360
18	360	52	4.5	1.7	99	0	27	0.1	0	360
19	380	55	4.7	1.2	99	0	27	0.1	0	360
20	400	58	5.0	0.8	10	0	27	0.1	48	360
21	420	60	6.0	0.5	18	0	27	0	51	360

Table-1: Data of results obtained during the study

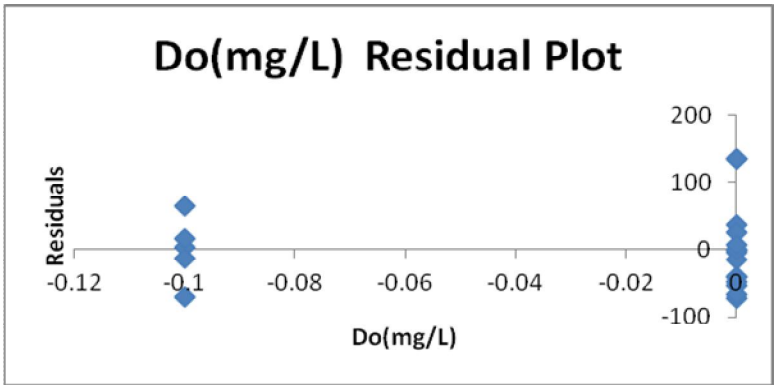


Figure 11: Graph of Dissolve oxygen residual plot

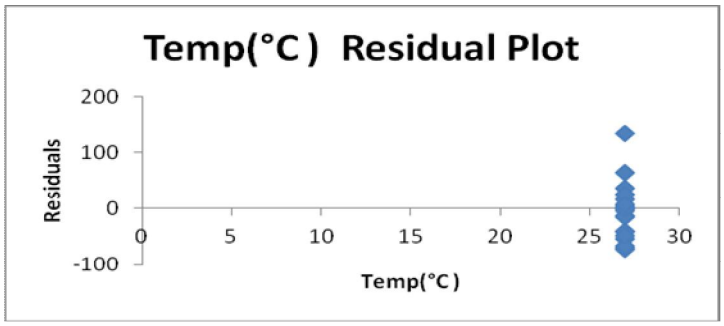
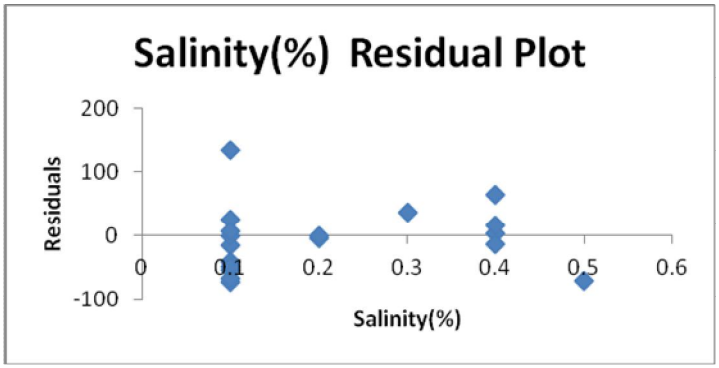


Figure 12: Graph of temperature residual plot

Figure 13: Graph of Salinity residual plot



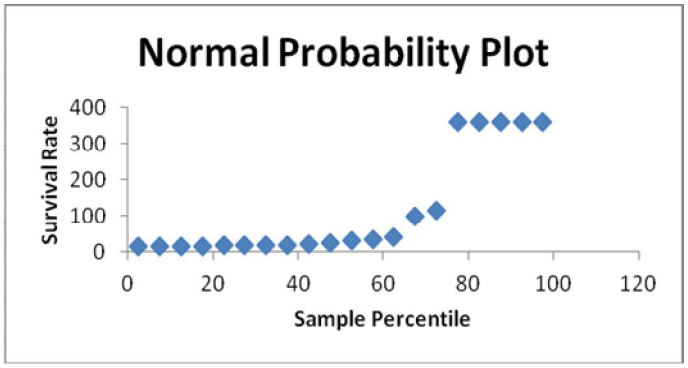


Figure 14: Graph of normal probability plot (Survival Rate)

4.0 Conclusion

Results from the present study indicates that, Stand Alone Toxin Removal Machine which is designed and tested in the present study can be used to replace and reduce the human work in the production, by simple procedure of operating the machine by circulation of water. The proposed method is very simple whereby tubers are need to be sliced into small pieces before washing by flowing water using this machine as the circulation of water plays important role in the operation. The time required for removal of toxin from tubers is also less when the machine is used which will help in toxin removal faster out from tuber then the manual process.The outcome of the proposed method points that toxins can be removed from *Dioscorea hispida* tubers easily and efficiently.

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