Albio: Design And Fabrication Of An Algae Bio-Fertilizer Machine

Leah Q. Santos, Jessa Ornopia, Christian Cahayag, Jon Michael Cueno, Edwin Egagamao, Ranzel Dave Florido

Abstract: The research aims to develop a machine that would produce an Algae Bio-fertilizer Machine out of algae waste. The machine has drying, grinding and sieving system for the harvested algae. The automation is done by the program using Arduino software. The study is supported by gathering information through data analyses and laboratory testing. The researchers used 250 grams of algae as input to machine. It has an average of 66.6% of moisture content for the input algae. The AlBio Machine achieved 10% moisture content on the pulverized algae. The Algae Bio-fertilizer Machine established the whole processing time in just .234 hours or 14.05 minutes that made the innovated system more efficient than the conventional way of drying it. The machine was proven efficient and reliable based on the results undertaken. To further improve the moisture content of the resulting algae bio-fertilizer, exposition to sunlight after the wringing process is recommended.

Index Terms: algae, bio-fertilizer, moisture content, automation, wringing, drying, grinding, sieving

1 INTRODUCTION

Algae are microscopic plant-like organisms that naturally fond in most marine and freshwater environments. A rapid increase in the algae population is called algal bloom. Harmful algal blooms are a major environmental problem worldwide. According to the United States Environmental Protection Agency [1], Red tides, blue-green algae, and cyanobacteria are examples of harmful algal blooms that can seriously affect human health, aquatic ecosystems, and the economy. Such negative biological impacts often have negative economic effects on the people, visitors, government and businesses affected. Despite algae's negative and harmful effects on the economy, it can also be very useful and beneficial. Algae are used as fertilizers, resulting in less runoff of nitrogen and phosphorus than results from the use of manure from animals. This increases the water quality that flows across rivers and oceans. The Agricultural Research Service conducted a study of corn and cucumber seedlings grown in commercial fertilizer and seedlings grown in potting mixes containing algae, finding that the seedlings performed better with the algae mixes as compared to commercial fertilizer [2].

1.1 Objectives of the Study

The research entitled "AlBio: Design and Fabrication of Algae Bio-fertilizer Machine" aims to develop a machine that would produce an Algae Bio-fertilizer out of algae waste.

Specifically, the study aimed to:

1. Design and fabricate a machine with drying and grinding system for the harvested algae.
2. Design a control system for drying, grinding and sieving processes.
3. Develop a program using Arduino software for the automation of the AlBio machine.
4. Test and evaluate the machine in terms of efficiency and reliability

1.2 Operational Framework

Figure 1 shows the hardware and parameters and all the requirements in making the prototype. The operational framework diagram below shows the inputs, processes and output of the algae bio-fertilizer machine. The input shows what will be needed to start the main process. Processes shows the system operations after putting the inputs, and finally, the output for the actual project outcome.

1.3 Significance of the Study

This project entitled "AlBio: Design and Fabrication of an Algae Bio-fertilizer Machine" have the following benefactors:

Environment.

In addition to their plant productivity, bio-fertilizers contribute to the sustainability of soil fertility and to a reduction of the hazards of pollution

Agriculture.

The Bio-fertilizer will benefit the farmers in fertilizing their crops instead of using chemical fertilizer.

Future Researchers

The ideas in this study can be used as a new reference by researchers in conducting a further research about the biofertilizers.

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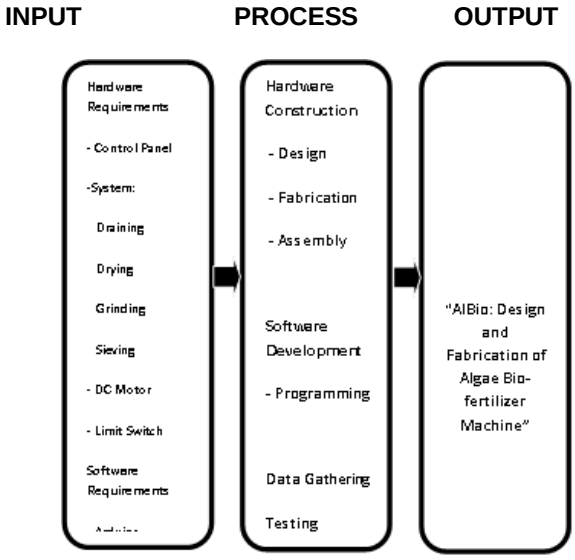


***Fig. 1**. Operational Framework for AlBio Machine*

1.4 Scope and Delimitation

The scope of this study is the development and fabrication of an algae bio-fertilizer machine. In this study, the researchers used no particular type of algae. The researchers focused on drying and pulverizing the algae and used Arduino software to make it automated. It used 250 grams of algae as input to AlBio Machine, but could increase the amount not greater than 1 kilogram. To avoid the waiting time in processing the algae as well as the increase in moisture content of the pulverized algae. This study did not include the collection of algae using the machine and the process of rinsing the algae with water is not supported by the study This research used pond algae as a raw material. It did not include the packaging of the algae as well as the mixing of the pulverized algae with the soil. The study did not include any additional bio-fertilizer such as corn husks and sugarcane as extenders.

2 LITERATURE REVIEW

Nowadays, there were several studies conducted that algal blooms produces a huge impact to marine life, human health, and even to human wellbeing. The study of Bauman et al. [3] shows that Tropical harmful algal blooms (HABs) are increasing in frequency and intensity and are substantially affecting marine communities. With rapid changes in ocean temperature, increased coastal eutrophication, and increased global distribution of HAB species within ballast water, large-scale HAB events are expected to increase dramatically in severity and distribution, with increasingly negative effects on coral reef ecosystems worldwide. There are different species of blue-green algae that can produce toxins capable of causing illness in humans and animals. These toxins can cause gastroenteritis, neurological disorders, and possibly cancer [4].According to the study of Berdalet et al. [5], HABs can affect other aspects of human well-being, including human commercial and recreational uses of the coastal and marine environments, such as fishing, shellfish collection and growing, and tourism, and non-market, passive uses of the ocean, such as preferences for particular ecological states.

2.1 Benefits of some Algae Species

It is probably not a good idea to try to extract freshwater algae. Of the hundreds of algae varieties that grow in freshwater, three are listed as beneficial and are commonly marketed as dietary supplements. Chlorella is a green alga, while Aphanizomenon flos-aquae, or AFA, and spirulina are both blue-green algae. In findings published in the December 2009 issue of the “Korean Journal of Food Science and Technology,” they reported that chlorophyll showed promise in both the prevention and treatment of cancer and photo-aging caused by UVB radiation.Based on the research of Bast [6], in beneficial algae species, the algae have a chlorella that is rich in chlorophyll that gives many plants and some algae species their green color. When the plants turn’s green, it reduces the carbon dioxide level, increasing humidity, reduces the level of certain pollutants, reducing airborne dust levels and keeping air temperatures down.According to the research of Chatterjee et al. [7], algal bio-fertilizers like the Blue-Green Algae have the potential to fix atmospheric nitrogen and are used in paddy fields. BGA bio-fertilizer in rice popularly known as “algalization” helps in creating an environment-friendly agro-ecosystem that ensures economic viability in paddy cultivation while saving energy-intensive inputs. With this research, it proves that algal species have great potential in bio-fertilizer technology in terms of productivity, eco-friendly, improving soil fertility as well as their natural occurrence in the paddy fields.

2.2 Bio-fertilizers in Agriculture

The Bio-fertilizer will benefit the farmers in fertilizing their crops instead of using chemical fertilizer. Bio-fertilizers are cost effective when compared to traditional fertilizers.

2.3 Factors needed in Bio-fertilizers

There are several factors needed to consider in creating bio-fertilizers. One of these is the moisture content of the algae. Moisture content— AKA water content— is a measurement of the total amount of water contained in a food, usually expressed as a percentage of the total weight (see calculation). It is a useful measurement for determining the dry weight of food and ingredients and it helps calculate the total yield. It can also be used to confirm whether the drying process of the foods is finished [8]. According to the article of Canedo et al., [9] for the Philippine National Standard, the specification for the solid organic fertilizer that is acceptable will have a moisture content of 10-35%.

2.4 Synthesis

Based on the past studies and literatures that have been gathered, the researchers believed that besides algae's harmful effects, it also has many uses and benefits. Some studies and researches in this chapter includes the use of algae in various ways such as fuel source, food supplement and as a bio-fertilizer. It is known that using a bio-fertilizer has the potential to increase the health and productivity of plant life and reduce the need to use chemical or synthetic fertilizers.The literature reviews and the methods of preparing and making algae fertilizer gave the researchers an idea of developing the design and fabrication of algae bio-fertilizer machine.

3 METHODOLOGY

The proponents used mixed-method research, quota sampling technique to gather all the data needed in the design. It also helped the proponents in determining how the process would

successfully work as well as the required materials needed to create the actual prototype. The proponents gathered more information regarding how the prototype created by asking some questions to professionals with related knowledge regarding the design.

3.1 System Flow Chart

In order to understand how the machine works, the researchers created a design flow chart as shown in figure 2.

***Fig. 2**. AlBio Machine System Flow Chart*

3.2 Block Diagram

The proponent used the block diagram to demonstrate the flow and the setup inside the AlBio Machine. The load cell give input data to the microcontroller to initiate the control system including the drying and grinding processes. The relay used to operate different peripherals like Grinder, Heat Gun, Corn Mill Grinder and Sieve Mechanism.

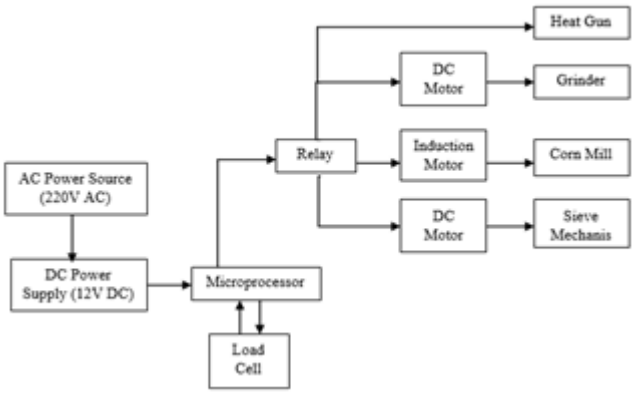
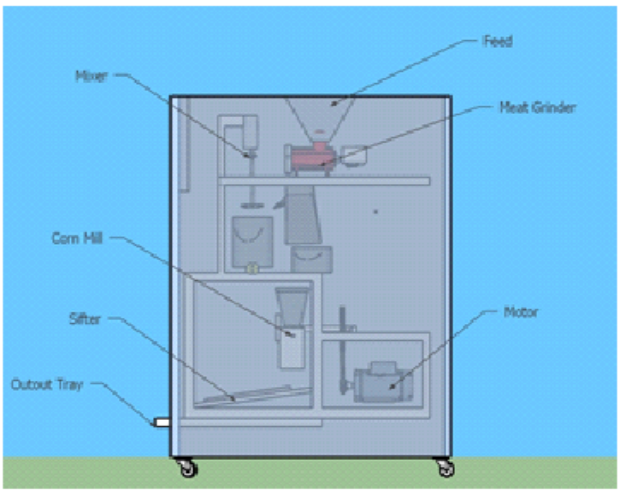


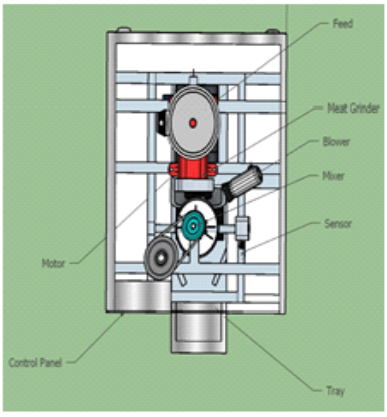
***Fig. 3**. AlBio Block Diagram*

3.3 Design and Construction

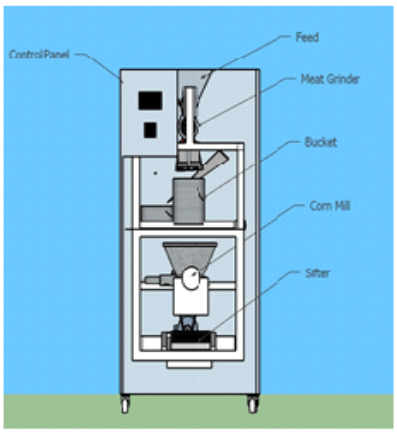
Figure 4 shows the design and construction of the AlBio Machine.



(a) Side – view



(b) Top – view



(c) Front View

***Fig. 4**. Algae Biofertilizer Machine Internal Parts*

***Fig. 5**. Actual Algae Biofertilizer*

4 RESULTS AND DISCUSSIONS

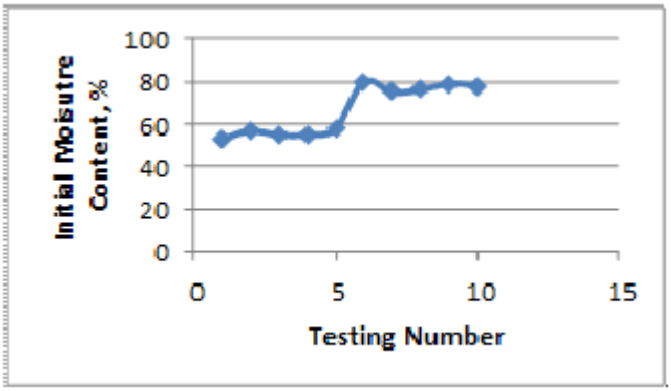


***Fig. 6**. Initial Moisture Content*

The graph shows the number of tests conducted with different moisture content which ranges from 53-80%.

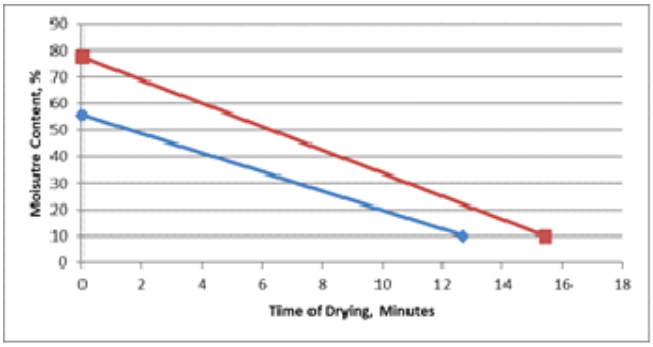


***Fig. 7**. Drying Process*

4.1 Equations

Moisture Content [8]:

$$MC = \frac{wet\ weight - dried\ weight}{wet\ weight}\ X\ 100\% \quad (1)$$

For the slope intercept form:

$$y = mx + b \quad (2)$$

TABLE 1
GRAPH DATA FOR SLOPE – INTERCEPT FORM

X	y	b
-3.59	-1	-55.6
-4.39	-1	-77.6

x = 27.5
y = -43.125

Computing for the average moisture removed from the algae using Algae Bio-fertilizer Machine:
The Effectiveness of the System:

$$\text{Ave. Moisture Removed (g)} = \frac{\Sigma\ \text{Number of Trials (Moisture Removed)}\,(g)}{\text{Total Number of Trials}}\ \text{x}\ 100\% \quad (3)$$

$$\text{Drying Effectiveness} = \frac{\text{Ave. Input Weight (g)} - \text{Ave. Moisture Removed (g)}}{\text{Ave. Moisture Removed (g)}}\ \text{x}\ 100\% \quad (4)$$

The Efficiency of the System:

$$\text{Ave. Output (g)} = \frac{\Sigma\ \text{Number of Trials (Output)}\,(g)}{\text{Total Trials}}\ \text{x}\ 100\% \quad (5)$$

Reliability of the System:
Based on the test done by the researchers, the results after 10 trials shows that the Algae Bio-fertilizer Machine achieved nearly the same output moisture content.

Laboratory Testing for Moisture Content
From figure 5, the algae were tested using gravimetric measurement to determine the moisture content of the wet and dry algae.


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***Fig. 8**. Laboratory Result for Algae Moisture Content*

5 SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Summary

Through the use equation (2), the researchers were able to get an average moisture content of 55.6% which dried in 12.7 minutes, while it took 15.4 minutes for the yielded average moisture content of 77.6%.The 250 grams of algae was used as input to the machine. It yields different moisture content that ranges from 53-80%. The average of 66.6% of moisture content was determine for the input algae. Using equations (3), (4), and (5), the study achieved 10% moisture content on the pulverized algae. From the results made by JEFCOR Laboratories, Inc., the moisture content for the input and pulverized algae is 35.11% and 24.79% respectively. The Algae Bio-fertilizer Machine established the whole processing time in just .234 hours or 14.05 minutes that made the innovated system more efficient than the conventional way of drying it.

5.2 Conclusion

Waste management, nowadays, is becoming an issue in every country. As a citizen, there are simple ways to lessen unwanted wastes in the environment. Just by looking at the streets, it is noticeable that there are ditches along the roads. As long as waters run through these channels, there is a variation of bacteria arising which causes the forming of Algae. To make the organism usable in some various ways instead of treating it as an unwanted waste, algae are utilized into fertilizers by drying it through the means of exposing it to sunlight for effective composting. The researchers thought that to make the conventional process easier, automation can be applied which made Design and Fabrication of Algae Bio-fertilizer Machine possible.This project design and fabrication of Algae Bio-fertilizer Machine showed The reliability of the system was tested by undergoing a certain number of trials and achieved 10% moisture content on the output algae, despite dissimilarities on the percentage of water present at the input samples of algae and the time taken to process it. The proponents desired to apply automation to lessen the time of drying the algae by exposing it to sunlight, which takes up to 5.1 hours. The Algae Bio-fertilizer Machine established the whole processing time in just .234 hours or 14.05 minutes that made the innovated system more efficient than the conventional way of drying it.In conclusion, through the combined concepts of mechanical and electronics engineering merging ideas whilst green innovation can be promoted, along with other aspects of engineering which may contribute more discoveries by exploiting wastes present at the environment. As this paper's principal subject, using algae as raw material to produce Bio-fertilizer helps to reduce the number of waste of algae in various communities. A system like Design and Fabrication of Algae Bio-fertilizer Machine, from the definition of 'automated' itself, is generated to lessen the time it takes to achieve the said output and to advocate human health for it is more convenient and requires interaction from the user.

5.3 Recommendations

The researchers of this project encountered minor difficulties in various elements involve in the system. These unavoidable circumstances could pave a way to the future researches whose interested in further developing this project.The project's "Squeezing" could be improved by using other methods for squeezing the raw material(algae).The project's temperature could become critical due to the repeated use of a heat gun if its use continuously without interval. If the future researchers could come up with a better drying system, it would benefit the prototype such as making an exhaust system so that the temperature on the machine inside will cool down. The project's grinding system could be improved by having a better grinder to further pulverized the output. Future researchers could come up with a better grinding system to make the output algae completely powdered.

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