

# Hong Kong Student Science Project Competition 2022

Template of Extended Abstract (Investigation)

(Word Limit: 1,000 words, Pages: 2 pages only)

**Team Number:** JBBC131

**Project Title:** Effects of Spent Coffee Grounds Biochar on the Absorption of Heavy Metal Ions

**Project Type:** Investigation

To our best knowledge and after thorough literature research, as at 30/6/2022, there are / are no similar works. If there are, the reference links are as below:

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## I. Background

Heavy metal pollution in different areas, for example, in soil or aquatic environments, affects our health. Coffee brings 23 million tons of spent coffee grounds residue per year, producing a chemical substance called methane, which is worsening global warming. To stop these problems, the making of biochar from spent coffee grounds was studied.

## 1. Objectives

- To develop a method to produce spent ground coffee biochar
- Test the copper ion absorption properties of the spent coffee biochar
- Investigate the effects of biochar on the growth of plant

## 1. Hypothesis

- Biochar produced by spent ground coffee absorbs copper ions, both in solution and in soil
- Biochar produced by spent ground coffee promote the growth of plants

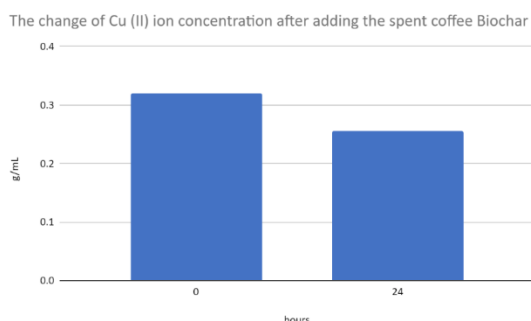
## 1. Methodology

1. The spent ground coffee biochar was added into different concentrations of ( $\text{Cu}^{2+}$ ) ions. The time needed for investigating the absorption depended on the size of the spent ground coffee biochar. Besides, the Arduino Science Journal was used for the observation of the absorption of ( $\text{Cu}^{2+}$ ) ions.
2. Four green beans were placed on four plant pots: biochar and normal potting with and without  $\text{Cu}^{2+}$ , normal potting with  $\text{Cu}^{2+}$  and normal potting soil as control. The lengths of seedlings were recorded every day.
3. Soil from a local farmland in Hong Kong was collected. We investigated the amount of heavy metal ions ( $\text{Cu}^{2+}$ ) in soil without biochar treatment and soil with the addition of biochar after 24 hours. The result is measured by a commercial copper concentration testing kit.

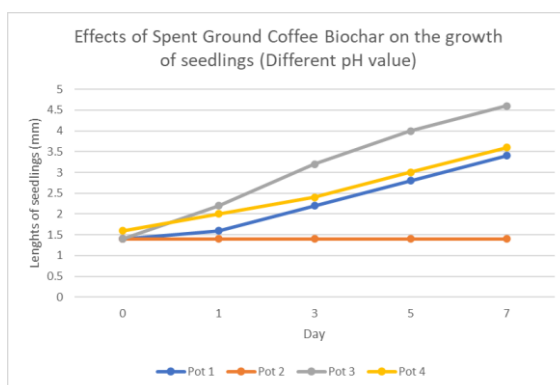
## 1. Results

Absorption of heavy metal ions ( $\text{Cu}^{2+}$ ) by spent ground coffee biochar

The concentration of ( $\text{Cu}^{2+}$ ) ions after putting spent ground coffee biochar was found to be decreased after 24 hours. This reflected that the spent ground coffee biochar has the ability of absorbing heavy metal.



Effects of Spent Ground Coffee Biochar on the growth of seedlings (Different pH value)



We have developed methods to produce spent coffee grounds biochar, both in secondary school laboratory and at home. An economical and attainable method was invented to measure the concentration of coloured ions using a smartphone App (Arduino Science Journal). Experimental results show that the produced biochar can absorb heavy metal ions ( $\text{Cu}^{2+}$ ). The pot with spent coffee grounds biochar has also grown better than the pot without biochar. Also, it is found that spent ground coffee biochar also had the ability to promote growth of plants in acidic medium.

## I. Conclusion

Spent ground coffee biochar can absorb heavy metal, for example in soil and water. When compared with the commercial activated charcoal, spent coffee grounds biochar is totally environmentally friendly and can also be made at home. The biochar can be put into a pot or fish tank to absorb the heavy metal in soil or water respectively. Our project provides an insight to the development of methods of using coffee residue for local farmers in Hong Kong to achieve sustainable and environmentally friendly farming.

**✘ Our project is developed based on our school's previous project and the enhancement is as below:**

This is a new project in our school but we used this project to participate the 'Hong Kong Youth Science and Technology Innovation Competition 2021-22.