

**A COMPARATIVE STUDY ON THE WATER HOLDING CAPACITY,
AERATION AND POROSITY OF COCOPEAT MADE FROM DIFFERENT
VARIETIES OF COCONUTS**

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Iloilo City

In Partial Fulfillment of the
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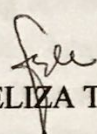
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APPROVAL SHEET

This Research Paper Hereto Entitled:

**"A COMPARATIVE STUDY ON THE DIFFERENCE OF WATER HOLDING CAPACITY,
AERATION AND POROSITY OF COCOPEAT MADE FROM DIFFERENT VARIETIES OF
COCONUT"**

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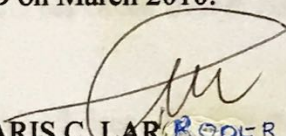

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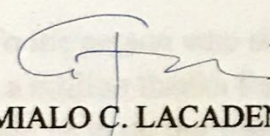
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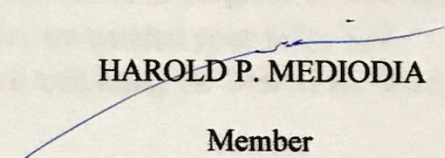
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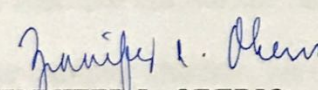
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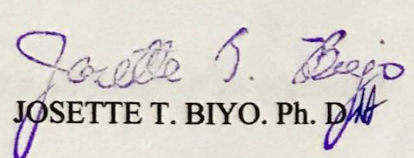

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LITERATURE CITED

APPENDICES

Payba, John Daniel S., Lim, Jon Patrick V. A comparative study on the difference of water holding capacity, aeration and porosity of cocopeat made from different varieties of coconut. Iloilo City. January 2010.

Abstract

About 25% of a coconut's weight comprises the mesocarp or husk (coir). Coir is comprised of fiber and coir dust (cocopeat). Cocopeat is the material that is found from the fiber portion of the coconut husk. Although there are studies that praise cocopeat for being beneficial to plants, it must be noted that cocopeat does not provide nutrients to plants. Rather, the ability of the cocopeat to absorb water and nutrients is what makes them a good growing medium.

This study compared and measured the differences in the three properties: water holding capacity (%), porosity (%) and aeration (%) of cocopeat made from each coconut variety: native coconut (*Cocos Nucifera*), macapuno, and golden coconut. The fiber portion of the coconut husks from each variety of coconut was cut and then blended using a blender to extract the binding materials. The binding material (coir pith) is the source of cocopeat. The pore volume, aeration pore volume and water holding capacity was measured using a cocopeat-water set-up.

Results showed that the cocopeat made from native coconuts have a higher porosity (93.33%) and water holding capacity (64.40%) compared to the porosity and water holding capacity of cocopeat made from macapuno (86%, 54.27%) and golden coconuts (82.13%, 52.67%). In terms of aeration, the cocopeat made from native coconuts (26.93%) has the least aeration percentage compared to the other cocopeat made from macapuno (31.73%) and golden coconuts (29.47%). In conclusion, cocopeat made from native coconuts is the best variety of coconut to be used for production of cocopeat.

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CHAPTER 1

INTRODUCTION

A. Background of the Study

There is around fifty million tons of coconut fruits produced annually. About 25% of this weight is the mesocarp or husk (coir). Coir is comprised of fiber and coir dust (cocopeat) (Nichols 2004). Cocopeat is the material that is found from the fiber portion of the coconut husk. It is a good absorbent and it could even be used as an oil absorbent for slippery floors. It is also used as bedding in animal farms and even pet houses to take up animal waste so that the farms and pet houses are kept clean and dry.

Cocopeat is also used extensively in horticulture for making potting compost. It has been considered as a waste product by coir fiber producing countries in the past; and for some, even up to now. Cocopeat as such has been left to rot and decompose. But now, in horticulture, it is a soilless medium that is a recommendation to replace peat (Addison, 2008).

Although there are studies that praise cocopeat for being beneficial to plants, it must be noted that cocopeat does not provide nutrients to plants. Rather, the ability of the cocopeat to absorb water and nutrients is what makes them a good growing medium.

Noguera, P. and others (2003) have stated that particle size have significant effects on the physical properties of cocopeat, especially on air-water relationships. It is observed that the water holding capacity of cocopeat does well in humid and dry conditions because of its slow water releasing capacity. Cocopeat is economically cheap, ready to use, excellent medium for hydroponics growing, seed sowing, potting mixes, commercial floriculture, flowerbeds, commercial horticulture, landscaping, soil reconditioning, golf courses, mulching, nursery gauge planting and potted plants.

A coconut, botanically, is a simple dry nut known as fibrous drupe. Cocopeat, named also as coir dust or coir pith, is produced by extracting the fibers from the husk of a coconut. In this study, three varieties of coconut are used; native coconut, macapuno and golden coconut. This study aimed to know if there are any differences in the properties of cocopeat made from different coconut varieties.

B. Statement of the Problem

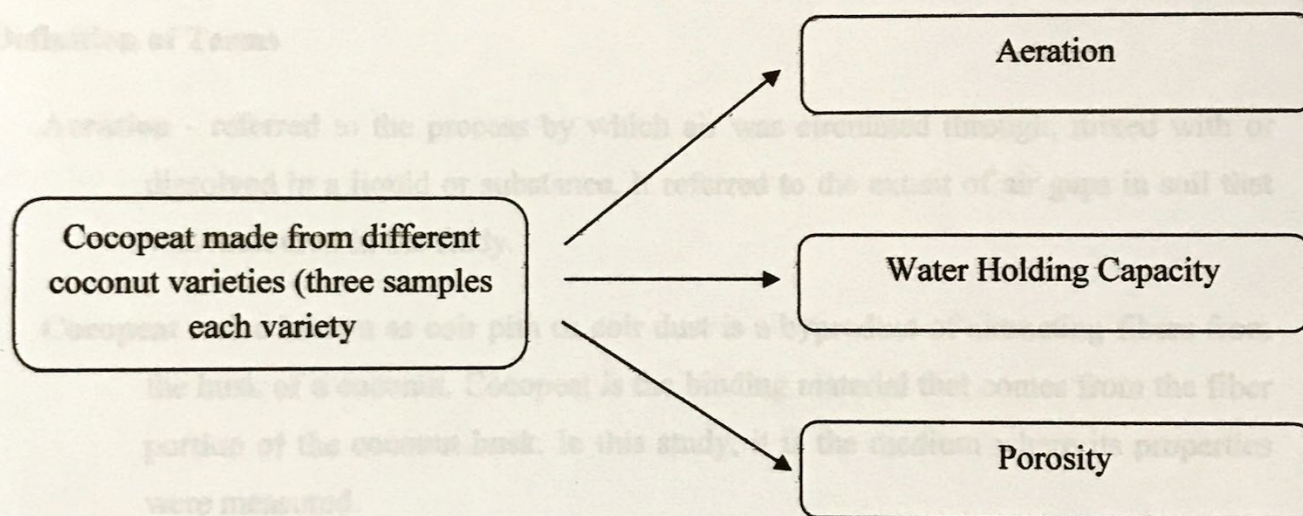
What are the differences in the properties of cocopeat made from three different coconut varieties?

C. Objectives of the Study

This study:

1. Measured the three properties: (1) water holding capacity, (2) aeration and (3) porosity of cocopeat made from each coconut variety: (1) Native (*Cocos nucifera*), (2) golden coconuts and (3) macapuno
2. Compared the differences in the three properties: (1) water holding capacity, (2) aeration and (3) porosity of cocopeat made from the different coconut varieties.

D. Research Design



E. Significance of the Study

Doing this study establishes the theory that cocopeat made from native coconuts is the best variety to be used for producing cocopeat. Cocopeat made from native coconuts has the highest water holding capacity and also has the largest pore space, compared to the other cocopeat made from the two other varieties.

Results of this study contributes to the increasing body of information concerning about cocopeat. Cocopeat is used for seed starting mixes, bedding plants, planters, gardens and

container plants. In Thailand, the coconut husk (cocopeat) is used as a potting medium because of its cost effectiveness to produce healthy forest tree samplings. The process of husk extraction from the coir bypasses the retting process, using a custom-built coconut husk extractor designed by ASEAN Canada Forest Tree Seed Center (ACFTSC) in 1986.

In this study, the target beneficiaries are hydroponic growers, farmers, agriculturists, floriculturists, horticulturists and planters. Cocopeat would be a great help for them in growing their crops, flowers and plants.

F. Scope and Delimitations

This study measured the water holding capacity, total aeration, total pore space or porosity. The duration of the study was approximately sixty days or two months. The varieties of coconut used were native coconut (*Cocos nucifera*), golden coconut and macapuno.

G. Definition of Terms

Aeration - referred to the process by which air was circulated through, mixed with or dissolved in a liquid or substance. It referred to the extent of air gaps in soil that was measured in the study.

Cocopeat - also known as coir pith or coir dust is a byproduct of extracting fibers from the husk of a coconut. Cocopeat is the binding material that comes from the fiber portion of the coconut husk. In this study, it is the medium where its properties were measured.

Porosity - referred to the measurement of the void spaces in a material that was measured in the study, and was measured as a fraction, between 0–1, or as a percentage between 0–100%. Porosity of surface soil typically decreases as particle size increases. This is due to soil aggregate formation in finer textured surface soils when subject to soil biological processes.

Water holding capacity - is dependent upon the organic matter in the soil and soil particle size. Water holding capacity of soil was measured in the study and it referred to the total quantity of water the soil can hold.

A. Coconut Palm

Botanically, a coconut is a simple dry nut known as a fibrous drupe. The husk, or exocarp, is composed of fibers called coir and there is an inner shell, or endocarp. The endocarp is the hardest part. This hard endocarp, the outside of the coconut as sold in the shops of non-tropical countries, has three germination pores that are clearly visible on the outside surface once the husk is removed. It is through one of these that the radicle emerges when the embryo germinates. Adhering to the inside wall of the endocarp is the *mesocarp*, with a thick albuminous endosperm (the coconut "meat"), the white and fleshy edible part of the seed. (Mishra, 1997)

A.1. Native Coconut

Coconut Palm (*Cocos nucifera*) is a member of the Family *Arecaceae* (palm family). It is the only species in the genus *Cocos*, and is a large palm, growing to 30 m tall, with pinnate leaves 4-9 m long, pinnae 60-90 cm long, old leaves break away cleanly leaving the trunk smooth. The term coconut refers to the seed of the coconut palm. An alternate spelling is cocoanut.

A.2. Golden Coconut

It is also a coconut which belongs to the Family *Arecaceae*, the difference of golden coconut from the native coconut is its color. The color of the exocarp of the native coconut is color green, while the color of a golden coconut is color yellowish gold. That is why it is called "golden coconut".

A.3. Marapunu

This is also a coconut but the only difference of marapunu from native coconut (*Cocos nucifera*) is that it contains more meat. Inside the marapunu, it is filled with meat, there will be no sufficient room for air and water. It is also known as a mutant coconut because of its characteristics.

CHAPTER 2

REVIEW OF RELATED LITERATURE

A. Coconut Fruit

Botanically, a coconut is a simple dry nut known as a fibrous drupe. The husk, or mesocarp, is composed of fibers called coir and there is an inner stone, or endocarp. The endocarp is the hardest part. This hard endocarp, the outside of the coconut as sold in the shops of non-tropical countries, has three germination pores that are clearly visible on the outside surface once the husk is removed. It is through one of these that the radicle emerges when the embryo germinates. Adhering to the inside wall of the endocarp is the *testa*, with a thick albuminous endosperm (the coconut "meat"), the white and fleshy edible part of the seed. (Hahn, 1997)

A.1. Native Coconut

Coconut Palm (*Cocos nucifera*) is a member of the Family Arecaceae (palm family). It is the only species in the genus *Cocos*, and is a large palm, growing to 30 m tall, with pinnate leaves 4-6 m long, pinnate 60-90 cm long; old leaves break away cleanly leaving the trunk smooth. The term coconut refers to the seed of the coconut palm. An alternate spelling is cocoanut.

A.2. Golden Coconut

It is also a coconut which belongs to the Family Arecaceae, the difference of golden coconut from the native coconut is its color. The color of the exocarp of the native coconut is color green, while the color of a golden coconut is color yellowish gold. That is why it is called "golden coconut".

A.3. Macapuno

This is also a coconut but the only difference of macapuno from native coconut (*Cocos nucifera*) is that it contains more meat. Inside the macapuno, it is filled with meat; there will be no sufficient room for air and water. It is also known as a mutant coconut because of its characteristics.

B. Cocopeat

Cocopeat, named also as coir dust or coir pith, is produced by extracting the fibers from the husk of a coconut. Cocopeat is the material that is found from the fiber portion of the coconut husk. It has high lignin and cellulose content which makes it good for growing mushrooms which will flourish on the cellulose. It is a good absorbent and it could even be used as an oil absorbent for slippery floors. It is also used as bedding in animal farms and even pet houses to take up animal waste so that the farms and pet houses are kept clean and dry (Beheer R.J.H., 2008). Cocopeat makes a good growing medium for hydroponics, soil mixes, and for the plants growing in the container. This clean coir has natural rooting hormones and anti-fungal properties. (Anonymous, 2009). Cocopeat is even proved to be a natural substitute to peat moss in mines; therefore, using it helps slow down the extraction of peat from environmentally sensitive swamps worldwide. Used as a growing medium, cocopeat holds water rather than wasting it like any other traditional peat does. It can hold water 8-9 times of its own weight. Cocopeat can store and release the nutrients needed by plants for longer periods.

B.1. Economic Benefits of Cocopeat

Cocopeat provides as an organic alternate to rock wool and perlite media without the environmental disposal issues. Hydroponics crop production using cocopeat makes the opportunity to consistently maximize yield and provide better quality. The presence of organic compounds in cocopeat results to strong root growth compare with other growing medium. In addition it offers some natural resistance to plant diseases, so the plant live span will be long (Anonymous, 2008). Cocopeat is economically cheap, ready to use, excellent medium for hydroponics growing, seed sowing, potting mixes, commercial floriculture, flowerbeds, commercial horticulture, landscaping, soil reconditioning, golf courses, mulching, nursery gauge planting and potted plants (Shalimar, 2008).

C. Effects of soil porosity on plant growth

Growing mediums consist of solid particles, such as peat or bark, as well as the pore spaces both between and within these particles. These pore spaces are categorized into either large pores, which normally are filled with air, or the smaller pores, normally filled with water (Rouquerol J. and others, 1994).

Soil compaction is the process of increasing dry bulk density of soil and reducing pore space by expulsion of air through applied pressure on a soil body. Soil compaction is a limiting factor in seed germination, water transmission and aeration. Timely aeration and the incorporation of biological can prevent soil compaction. Soil compaction and the soil moisture content are commonly recognized as the primary factors that reduce the aeration of soil and damage the plant. (Ruark and others, 1982; cited in Glinski and Stepniewski, 1985; cited in Kozlowski, 1985; cited in Costello and others, 1991; cited in Day and others, 1995; cited in Craul, 1999; cited in MacDonald and others, 2004).

D. Effects of soil aeration on plant growth

Plant roots, like other plant parts, require air for the process of respiration. Plant roots that are not able to breathe properly are weakened and may exhibit disorders (Anonymous, 1998). According to Awang and others (2009), aeration depends mainly on the size of pores in a medium. Oxygen is required by microbe and plants for respiration. Oxygen taken up and carbon dioxide evolved are stoichiometric. Root elongation is particularly sensitive to aeration. Oxygen deficiency disturbs metabolic processes in plants, resulting in the accumulation of toxic substances in plants and low uptake of nutrients.

E. Effects of water holding capacity of soil on plant growth

Water is essential for plant growth. Soil is capable of being a storehouse of water and becoming the main source of water for land plants. Soil water plays a significant role in several natural processes- evaporation, infiltration and drainage of water, diffusion of gases, conduction of heat, and movement of salts and nutrients are all dependent upon the amount of water present in soil. Plants meet their water requirement from water stored in soil. Ingram and others (2003) reported that media (like cocopeat) which have small pores tend to retain more water, and

consequently have less aeration, than a medium having large pores. Soil moisture can be improved with aeration.

F. Porosity

Porosity is a measure of the void spaces in a material, and is measured as a fraction, between 0–1, or as a percentage between 0–100 percent. Porosity of surface soil typically decreases as particle size increases. This is due to soil aggregate formation in finer textured surface soils when subject to soil biological processes. Aggregation involves particulate adhesion and higher resistance to compaction (Horgan and others, 1991).

Between the soil particles there are empty spaces which are occupied by air and water and are termed as pore spaces. Pore spaces between the aggregates of soil particles are macropores and those between the individual particles of the aggregates are micropores. Sandy soils have a higher percentage of macropores.

Soils are made of particles of different types and sizes. The space between particles; is called pore space or porosity. Pore space determines the amount of water that a given volume of soil can hold. Porosity is the percentage of the total volume of soil that consists of pore space. This is an important measurement in areas where drinking water is provided by groundwater reserves.

G. Aeration

Aeration is the process by which air is circulated through, mixed with or dissolved in a liquid or substance. Aeration refers to the extent of air gaps in soil. Aeration commonly refers to the process of using mechanized equipment to either puncture the soil with spikes (spike aeration) or remove cores of soil from the ground (core aeration). Spike aeration involves the use of an aeration machine with spikes up to a foot or more in length. Spike aeration is sometimes used to address drainage issues in areas with turf. Core aeration is done on turf areas as a means of reducing turf compaction, reducing thatch buildup, improving the infiltration of water/nutrients, and creating an environment where grass seed can have direct contact with the soil (Anonymous, 2008).

$$\text{TOTAL POROSITY (\%)} = \frac{\text{Total Pore Volume}}{\text{Container Volume}} \times 100$$

H. Water Holding Capacity (WHC)

Water-holding capacity of dietary fiber is usually considered as the amount of water held but the manner in which water is held by the fiber matrix may be more relevant in understanding the role of fiber in nutrition. The WHC of fiber is a measure of the ability of a fiber source to immobilize water within its matrix (Robertson J.A. and others, 1981).

Water-holding capacity is dependent upon the organic matter in the soil and soil particle size. Normal field soil water-holding capacity is 60-80% of its total capacity; that is 60-80% of the water filled pore spaces are filled. This corresponds to the optimal biological activity of water-holding capacity. When the water-holding capacity falls below 55-60%, organisms could suffer from dryness; and when the capacity is over 80%, they begin to suffer from a depletion of soil oxygen. (Summer J., 2008).

Whiting and others (2006) noted that water holding capacity determines the texture and the structure of the soil. Water, after being absorbed by the soil, surrounds the soil particle and the organic matter found in the soil. It is then held in the small pore spaces by cohesion, the chemical forces by which water molecules stick together.

I. Measurement of Porosity, Aeration and Water Holding Capacity

The drainage hole in the container was sealed and filled with water. The volume of water in the container was measured and recorded as container volume. The container was emptied and dried and filled by growing medium. The growing medium was slowly saturated by pouring water gradually onto the surface. Water was added continuously over a period of several hours until the growing medium was completely saturated. The total volume of water added was recorded as the total pore volume. The container was placed over the watertight pan, and the seal from the container drain holes was removed. All free water was allowed to drain out of the container (this may take several hours). The amount of drainage water was measured and recorded as aeration pore volume. The total porosity, aeration porosity and water holding capacity were computed as follows (Liegel and Venator, 1987):

$$\text{TOTAL POROSITY (\%)} = \frac{\text{Total Pore Volume}}{\text{Container Volume}} \times 100$$

$$\text{TOTAL AERATION (\%)} = \frac{\text{Aeration Pore Volume}}{\text{Container Volume}} \times 100$$

$$\text{WATER HOLDING CAPACITY} = \text{Total Porosity} - \text{Aeration Porosity}$$

A. Materials to be used

- 150-ml. Pop Bottles
- 250-ml. Graduated Cylinders
- 100-ml. beakers
- 400-ml. beakers
- 1.0 L beaker
- Blender
- Markers
- Ovens
- Stationers (Wire)
- Screens (Cloth)
- Desiccator
- Rubber bands
- Tripods
- Micro funnels
- Cylar
- Styrofoam

B. Preparation

The collection of coconut varieties was done in Aklan and PSMS campus. Golden coconuts were gathered in the Philippine Science High School Campus, Marikina coconuts as well as the native coconuts were gathered in Altavas, Aklan. The husks of the coconut were removed from the inner portion of the coconut in order to get the desired material. The husks were placed under direct sunlight for five hours. The dried husks were cut into smaller parts and oven dried. Each coconut variety had three replicates.

CHAPTER 3

Methodology

A. Materials to be used

- 350-mL Pop Bottles
- 250-mL Graduated Cylinders
- 100-mL beakers
- 400-mL beakers
- 1.0 L beaker
- Blender
- Markers
- Oven
- Strainers (Wire)
- Screens (Cloth)
- Dessicator
- Rubber bands
- Tripods
- Micro funnels
- Cutter
- Styrofoam

B. Preparation

The collection of coconut varieties was done in Aklan and PSHS campus. Golden coconuts were gathered in the Philippine Science High School Campus. Macapuno coconuts as well as the native coconuts were gathered in Altavas, Aklan. The husks of the coconut were removed from the inner portion of the coconut in order to get the desired material. The husks were placed under direct sunlight for five hours. The dried husks were cut into smaller parts and oven dried. Each coconut variety had three replicates.

B.1. Production of Cocopeat

The fiber portion of the coconut husk was cut and then blended using a blender to extract the binding materials. The binding material (coir pith) is the source of cocopeat. After grinding the material, excess fibers were removed using a metal strainer. Next, the by-product (binding materials) was placed in a 400-mL beaker; then the binding material of the coconut fibers was oven dried using the oven, together with the silica gel at a temperature of 100 °C for four hours. The silica gel served as an absorber; it absorbed the moisture while the 400-mL beaker containing cocopeat was brought to the PSHS-WV Chemistry Stockroom. The same method was used for the other coconut varieties.

B.2. Constant Weighing of the Cocopeat

All replicates of different coconut varieties were placed in the dessicator. The dessicator was brought to the Chemistry Stockroom from the Research Laboratory. Constant weighing was made necessary because it can assure that there is no moisture found in the replicates. A range of 0.01 - 0.03 grams would ensure that the samples have a constant weight.

B.3. Preparation of Set-Up

Nine pieces of 335-mL plastic bottles were acquired. Using a graduated cylinder, 250-mL of tap water was measured. It was then transferred in the plastic containers. From the 250-mL mark, a 0.375-inch allowance was measured. The bottom part of the bottle was cut and wiped using a cloth.

A piece of cloth was cut to cover the mouth piece of the bottle. The cloth was secured using a rubber band. The bottle was then recapped.

The cocopeat made from the native coconut was placed in the plastic containers. The cocopeat was compressed by force until the container has reached its limit and not to exceed the 250-mL mark of the container.

Nine pieces of styrofoam with dimensions of 4x4x2 inches were cut out with a hole that would fit the diameter of the plastic container. Underneath the spout of each container, a micro

funnel was inserted in the opposite side of the hole. A 100-mL beaker was placed underneath the tubing of the funnel.

C. Measurement of Cocopeat Properties

The container had been emptied and a sample of cocopeat was obtained. Cocopeat that had been totally dried by placing inside the oven was at a constant temperature of 100 °C. The cocopeat was ensured to be dry before placing in the pop bottle. The plastic bottle was filled with dry cocopeat to the 0.375-inch mark line. The cocopeat was compressed by force, making sure not to let it exceed the mark line. After that, the water was added in the pop bottle slowly and thoroughly until it saturated. All water added was measured. Water added was the total pore volume or porosity.

The cap was removed from the pop bottle but the screen was left on the pop bottle to prevent the cocopeat from leaking out from the mouth of the bottle. The water was allowed to drain through the screen into the 100-mL beaker to measure the drained water. All water drained was measured; this was the aeration pore volume.

C.1. Porosity

To determine the total porosity, the total pore volume was divided by container volume.

$$POROSITY = \frac{\text{Total Pore Volume}}{\text{Container Volume}} \times 100$$

C.2. Aeration

Aeration was determined by dividing aeration pore volume by container volume.

$$AERATION POROSITY = \frac{\text{Aeration Pore Volume}}{\text{Container Volume}} \times 100$$

C.3. Water Holding Capacity

The water retention porosity was determined by subtracting the aeration porosity from porosity.

$$\text{WATER HOLDING CAPACITY} = \text{Porosity} - \text{Aeration Porosity}$$

D. Analysis of Results

After the total porosity was measured, the total aeration and the total water holding capacity of the cocopeat made from a native coconut (*Cocos nucifera*) was calculated, the results were averaged. The same procedure was made to the replicates of macapuno and golden coconuts. The total porosity, aeration and water holding capacity were measured and averaged. The results of porosity, aeration and water holding capacity of each coconut variety were compared.

As shown in Table 1, relatively, the cocopeat made from native coconuts have the highest percentage of porosity and water holding capacity and the least aeration compared to the other cocopeat made from macapuno and golden coconuts.

Table 1. Physical property value of cocopeat made from three varieties of coconuts. (Means of three replicates $\pm$ standard deviation)

Coconut Varieties	Properties		
	Porosity (%)	Aeration (%)	Water Holding Capacity (%)
Native Coconut	93.35 $\pm$ 1.22	26.93 $\pm$ 1.33	66.46 $\pm$ 1.39
Macapuno	84.30 $\pm$ 1.42	31.73 $\pm$ 1.67	54.27 $\pm$ 4.01
Golden Coconut	82.13 $\pm$ 0.92	29.47 $\pm$ 1.01	52.67 $\pm$ 1.29

CHAPTER 4

RESULTS AND DISCUSSIONS

This study aimed to measure the three properties of cocopeat (water holding capacity, aeration and porosity) of the different varieties of coconuts (native coconuts (*Cocos nucifera*), macapuno and golden coconuts). The study also aimed to compare the differences of the three properties of cocopeat made from different varieties of coconuts.

The pore volume, aeration pore volume and water holding capacity was measured using a cocopeat-water set-up.

A. Results

A.1. Properties of cocopeat made from different varieties of coconut.

As shown in Table 1, relatively, the cocopeat made from native coconuts have the highest percentage of porosity and water holding capacity and the least aeration compared to the other cocopeat made from macapuno and golden coconuts.

Table 1. Physical property value of cocopeat made from three varieties of coconuts. (Means of three replicates $\pm$ standard deviation)

Coconut Varieties	Properties		
	Porosity (%)	Aeration (%)	Water Holding Capacity (%)
Native Coconuts	93.33 $\pm$ 1.22	26.93 $\pm$ 1.33	66.40 $\pm$ 1.39
Macapuno	86.00 $\pm$ 3.42	31.73 $\pm$ 1.67	54.27 $\pm$ 4.01
Golden Coconuts	82.13 $\pm$ 0.92	29.47 $\pm$ 1.01	52.67 $\pm$ 1.29

A.2. Statistical analysis on the properties of cocopeat made from different coconut varieties

One-way analysis of variance (ANOVA) of the mean percent porosity, aeration and water holding capacity of cocopeat made from three different varieties of coconut showed a significant difference at $\alpha=0.05$.

Table 2. One-way Analysis of Variance (ANOVA) table for the properties of cocopeat made from different coconut varieties. (Native Coconuts, Macapuno and Golden Coconuts)

	F Ratio	P value	Interpretation
Porosity	20.76	0.002012	Significant
Aeration	10.15	0.01188	Significant
Water Holding Capacity	25.86	0.001123	Significant

The mean porosity and water holding capacity of cocopeat made from native coconut is significantly higher compared to the other cocopeat made from macapuno and golden coconuts which are statistically equal (Table 3).

For aeration, the cocopeat made from native coconuts has the least aeration percentage compared to the other cocopeat made from the other two varieties. Cocopeat made from native coconuts is significantly lower compared to the cocopeat made from macapuno. Aeration percentage of cocopeat made from native coconuts and golden coconuts are statistically equal. The same results are true for the aeration percentage of cocopeat made from macapuno and golden coconuts.

Table 3. Tukey's Multiple Comparison Test on the different pairings of coconut varieties for the different properties of cocopeat.

Comparison	Porosity		Aeration		Water Holding Capacity	
	Difference	Interpretation	Difference	Interpretation	Difference	Interpretation
Native Coconuts and Macapuno	0.014260	Significant	0.009923	Significant	0.002922	Significant
Native Coconuts and Golden Coconuts	0.001925	Significant	0.107700	Not Significant	0.001631	Significant
Macapuno and Golden Coconuts	0.151700	Not Significant	0.183800	Not Significant	0.735800	Not Significant

B. Discussion

The results showed that cocopeat made from native coconuts have a higher porosity compared to the cocopeat made from macapuno and golden coconut. Cocopeat made from native coconuts allowed more water and air to seep in the particles. It had a lesser aeration pore volume compared to the other cocopeat made from the other varieties of coconuts. The cocopeat made from the native coconuts allowed less air to fill the pores of the particles thus allowing more water to stay between the particles of the cocopeat.

The variety of coconut which has the highest percentage porosity and water holding capacity is the native coconuts compared to the cocopeat made from the other two varieties. For

aeration, cocopeat made from native coconuts allowed lesser air to fill the pores compared to the other varieties.

According to Awang and others (2009), aeration depends mainly on the size of pores in a medium. Irrigating media to the point of saturation fills the total pore space with water. As the media drains by the force of gravity, smaller pores remain filled with water while larger pores emptied and fill with air. However, materials with small particles such as cocopeat tend to fill up the pores, thus lowering the aeration pore volume. Plant roots, like other plant parts, require air for the process of respiration. Plant roots that are not able to breathe properly are weakened and may exhibit disorders (Anonymous, 1998). Ingram and others (2003) reported that media (like cocopeat) which have small pores tend to retain more water, and consequently have less aeration, than a medium having large pores. This supports the idea that the cocopeat made from native coconuts have a greater proportion of micropores than macropores. It has more micropores, thus allowing it to hold more water compared to the cocopeat made from the other two varieties and smaller proportion of macropores allows less air to enter the free spaces.

Growing media consists of solid particles, such as peat or bark, as well as the pore spaces both between and within these particles. These pore spaces are categorized into either large pores, which normally are filled with air, or the smaller pores, normally filled with water (Anonymous, ND).

Scherer and others (1996) reported that cocopeat has a high water holding capacity and most of this held water is plant-available. This water retention helps to prevent leaching and increases plant water use efficiency. Water is essential for plant growth. Without enough water, plant functions are disturbed, and the plant gradually wilts, stops growing, and eventually dies.

The cocopeat makes a good growing medium for hydroponics, soil mixes, and for the plants growing in the container, it is because of its acceptable pH, electrical conductivity and other chemical attributes but it is recognized to have high water holding capacity which causes poor air-water relationship, leading to low aeration within the medium, thus affecting the oxygen diffusion to the roots (Awang and others, 2009).

In other words, cocopeat made from different varieties of coconuts are recognized to have a high water holding capacity thus, causes poor water-air relationships leading to a poor aeration which can affect oxygen diffusion to the roots.

Generally, cocopeat made from native coconut is the best variety of coconut to be used for production of cocopeat. It is because it has the highest water holding capacity, compared to the other cocopeat made from the other two coconut varieties. It also have the largest pore space among the three cocopeat made from other varieties of coconuts.

This study aimed to compare the differences between the properties of cocopeat made from different varieties of coconuts.

This study specifically aimed to:

1. Measure the three properties: water holding capacity, aeration and porosity of cocopeat made from each coconut variety: native coconuts (*Cocos nucifera*), golden coconuts and mangrove.
2. Compare the differences in the three properties: water holding capacity, aeration and porosity of cocopeat made from different coconut varieties.

Summary of Findings:

1. The cocopeat made from the native coconuts attained the highest water holding capacity and porosity. Cocopeat made from native coconuts also attained the lowest percentage of aeration porosity.
2. By comparing the three different samples, cocopeat made from native coconuts showed the best results among the three varieties. The cocopeat from native coconuts have the highest water holding capacity and porosity. The same cocopeat also attained the least amount of air to displace the water between the pores of the cocopeat sample. Whereas the cocopeat made from golden coconuts have the least percentage of water holding capacity.

Conclusion:

Cocopeat made from native coconut is the best variety of coconut to be used for production of cocopeat. It is because it has the highest water holding capacity, compared to the other cocopeat made from the other two coconut varieties. It also have the largest pore space among the three cocopeat made from other varieties of coconuts.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This study aimed to compare the differences between the properties of cocopeat made from different varieties of coconuts.

This study specifically aimed to:

1. Measure the three properties: water holding capacity, aeration and porosity of cocopeat made from each coconut variety: native coconuts (*Cocos nucifera*), golden coconuts and macapuno.
2. Compare the differences in the three properties: water holding capacity, aeration and porosity of cocopeat made from different coconut varieties.

Summary of Findings:

1. The cocopeat made from the native coconuts attained the highest water holding capacity and porosity. Cocopeat made from native coconuts also attained the lowest percentage of aeration porosity.
2. By comparing the three different samples, cocopeat made from native coconuts showed the best results among the three varieties. The cocopeat from native coconuts, have the highest water holding capacity and porosity. The same cocopeat also attained the least amount of air to displace the water between the pores of the cocopeat samples. Whereas the cocopeat made from golden coconuts have the least percentage of water holding capacity.

Conclusion:

Cocopeat made from native coconut is the best variety of coconut to be used for production of cocopeat. It is because it has the highest water holding capacity, compared to the other cocopeat made from the other two coconut varieties. It also have the largest pore space among the three cocopeat made from other varieties of coconuts.

Recommendations:

It is recommended that further studies be made on the following:

1. A comparative study on the micropores and macropores of cocopeat made from different coconut varieties.
2. A comparative study between the differences in the properties (water holding capacity, aeration and porosity) of growing mediums other than cocopeat.
3. A comparative study between the differences in the properties other than water holding capacity, aeration and porosity of cocopeat made from different varieties of coconut.

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LIST OF PLATES

Plates 1-10 were placed under direct sunlight.

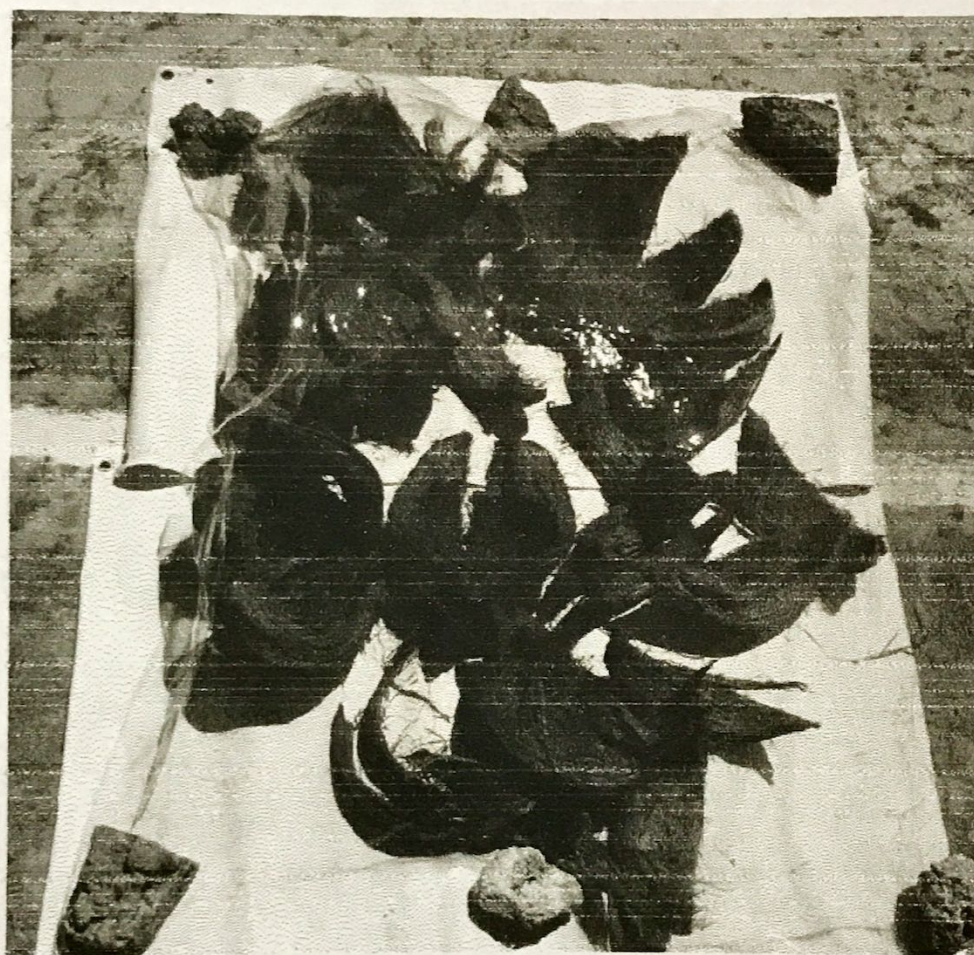


Plate 1: The husk were placed under direct sunlight.



Plate 2: The mesocarp were separated from the exocarp of the coconut.

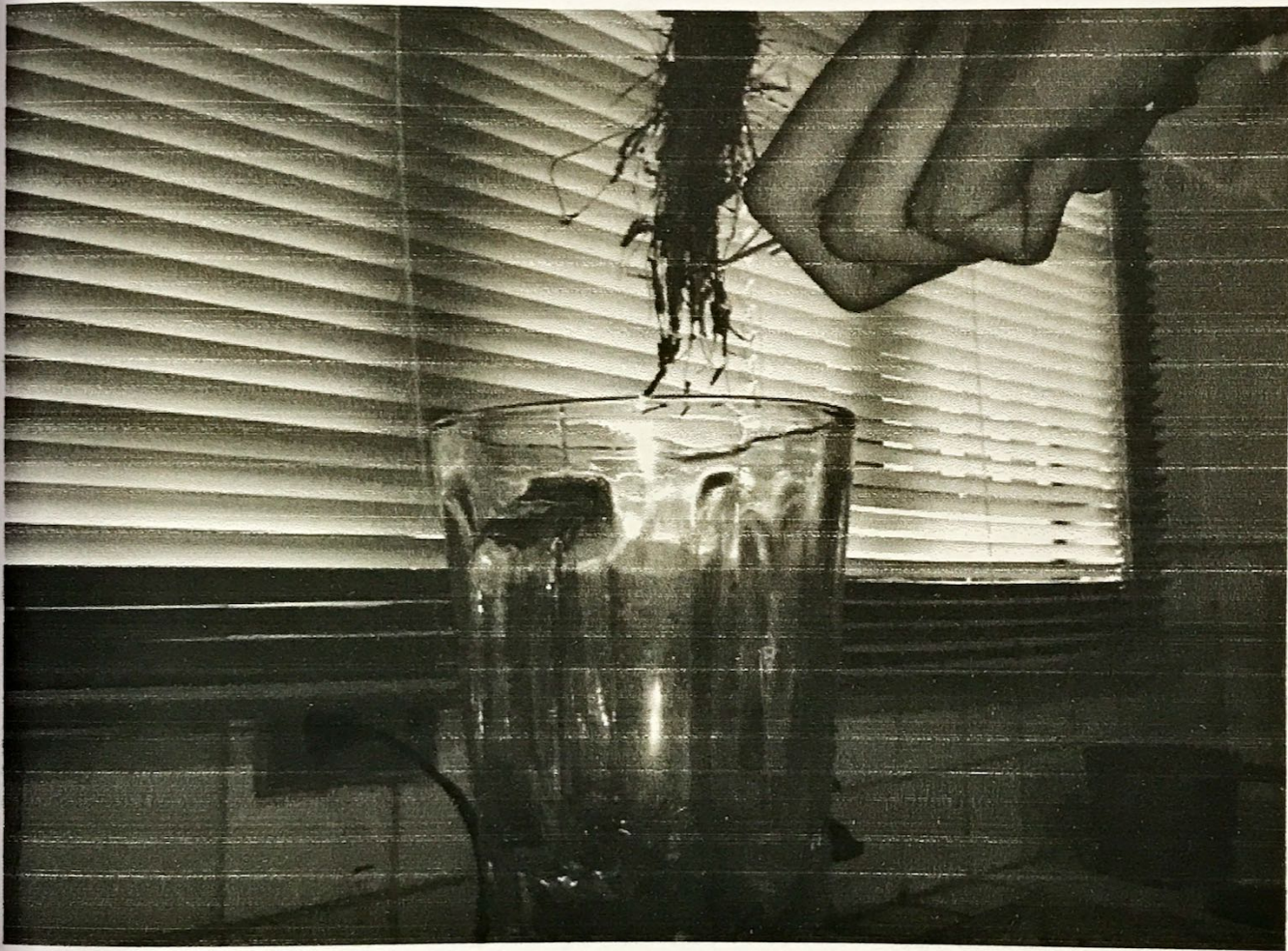


Plate 3: The strands of the coconut husks being cut for easier blending.

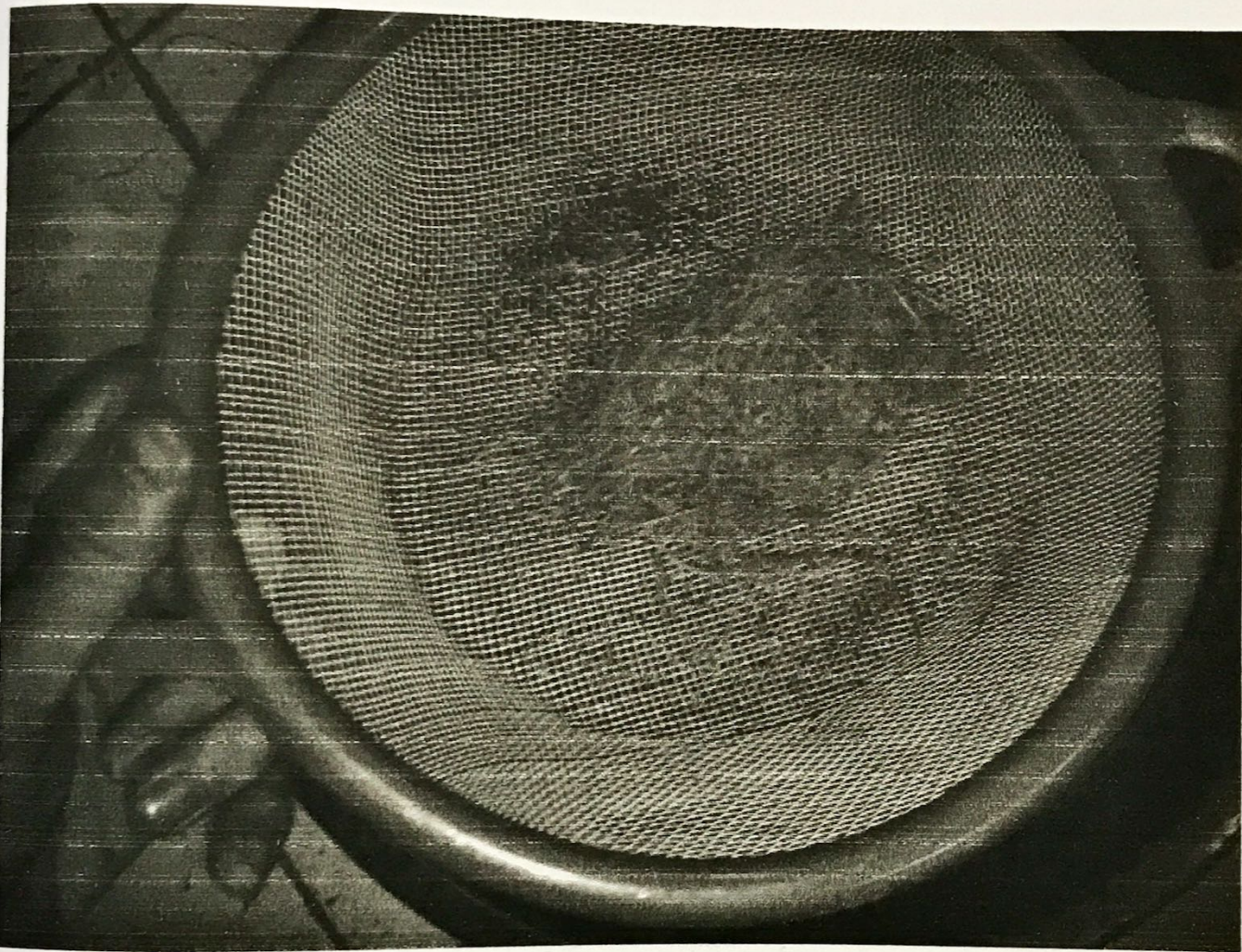


Plate 5: Separation of fibers from the cocopeat using a strainer.

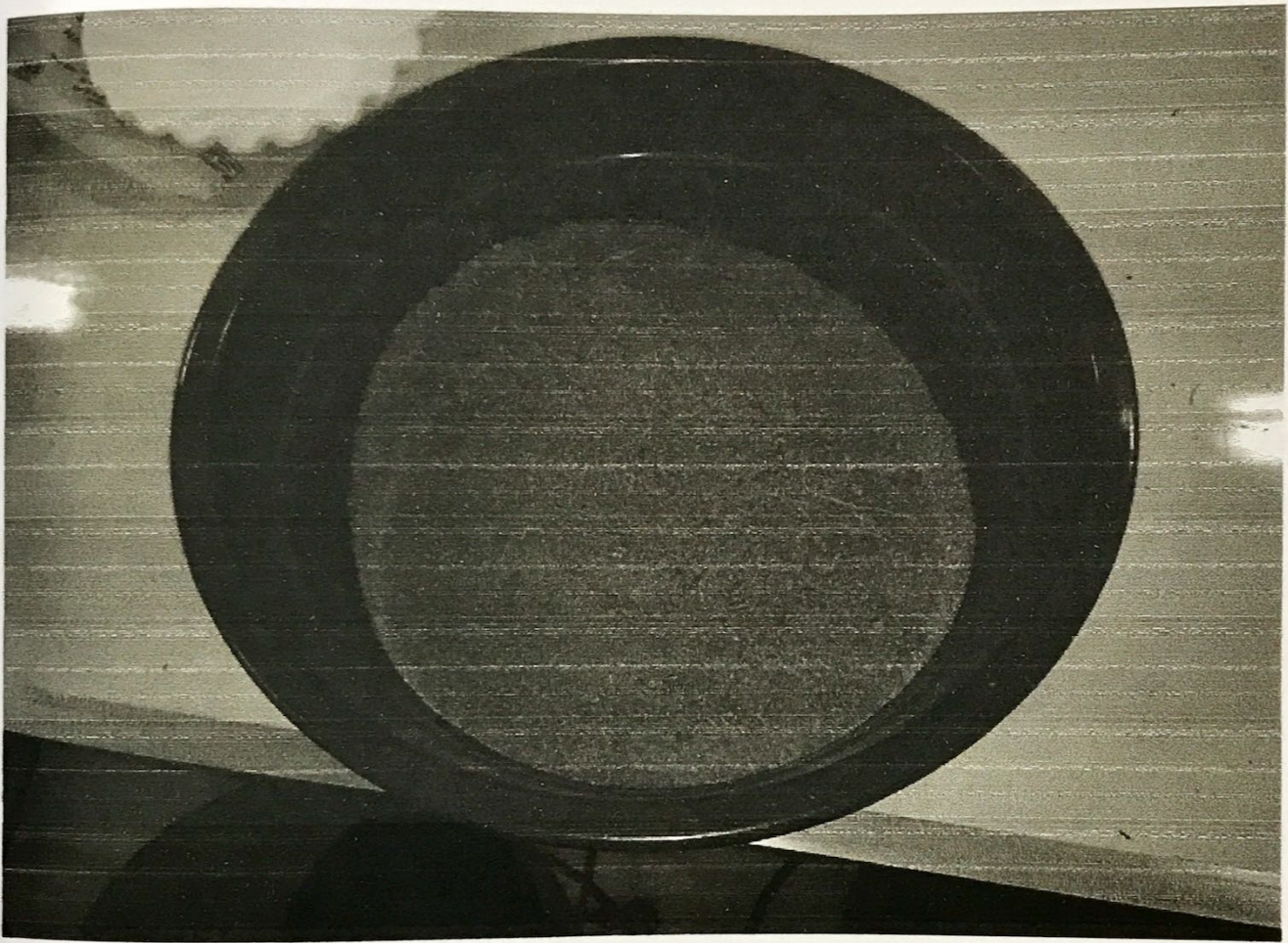


Plate 6: Final product of a hand-made cocopeat.



Plate 7: Heating of the cocopeat samples in the oven.



Plate 8: The cocopeat sample was placed inside the dessicator.

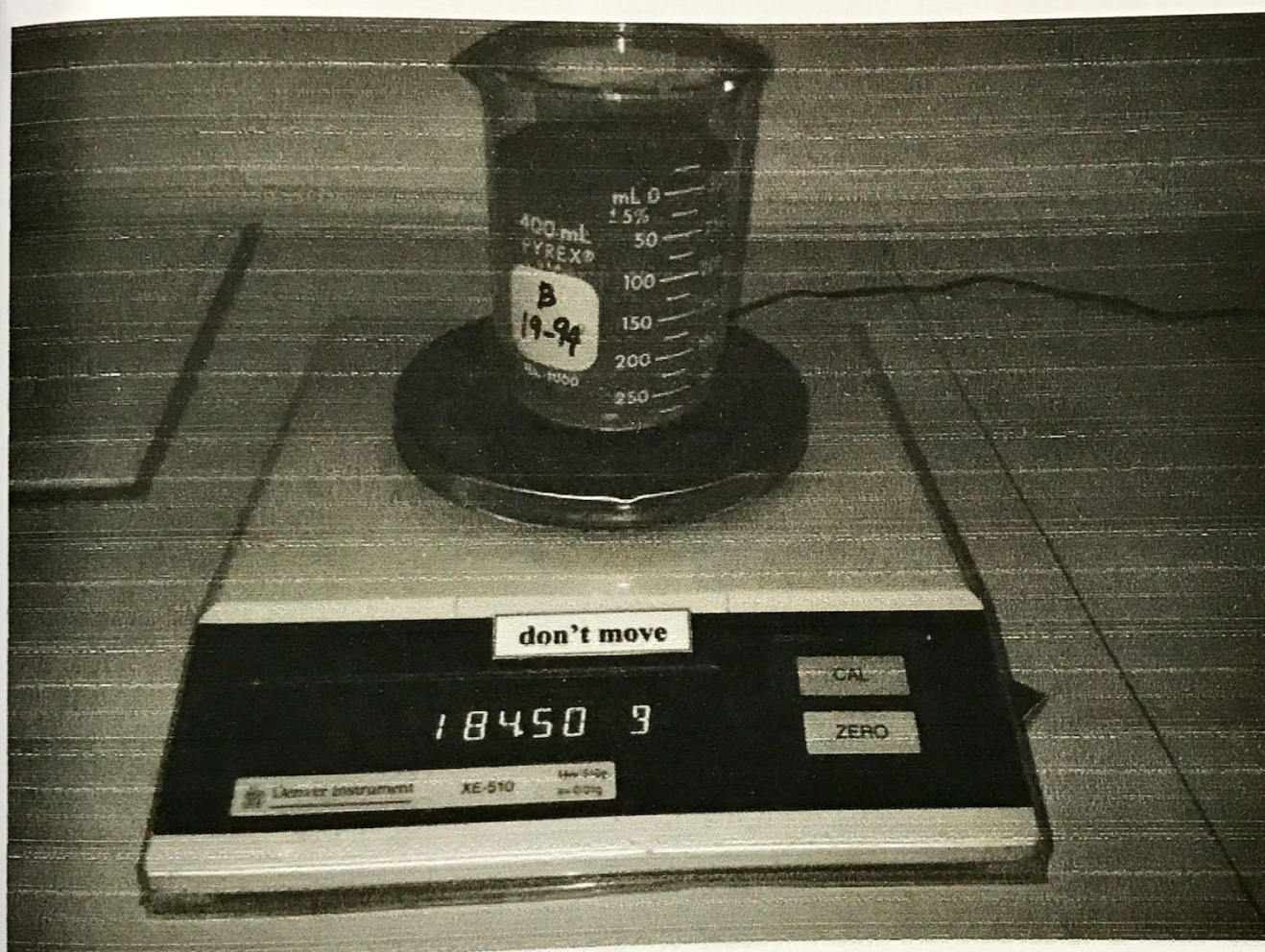


Plate 9: Constant weighing of cocopeat made from golden coconuts.

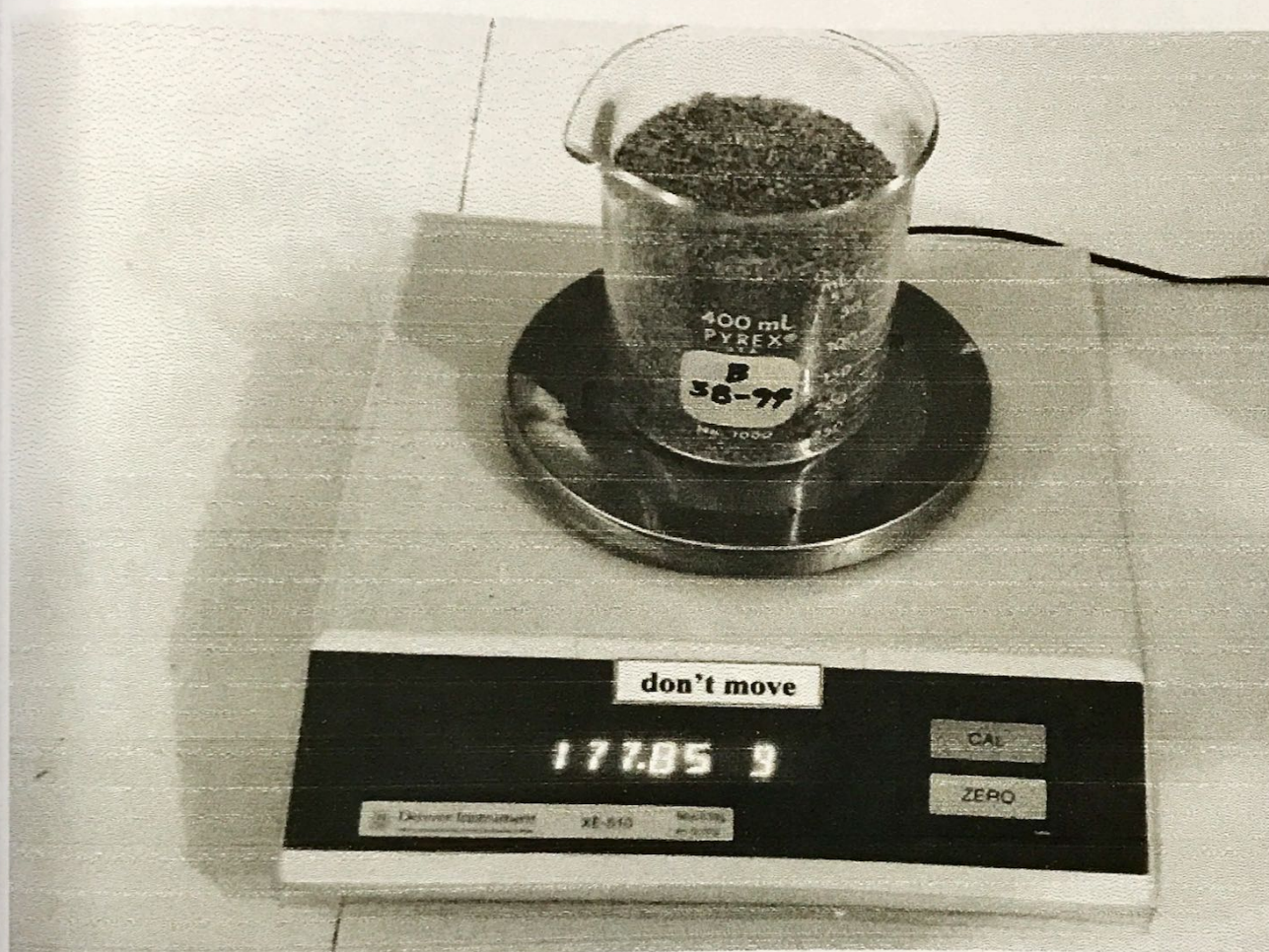


Plate 10: Constant weighing of cocopeat made from native coconuts (*Cocos Nucifera*).

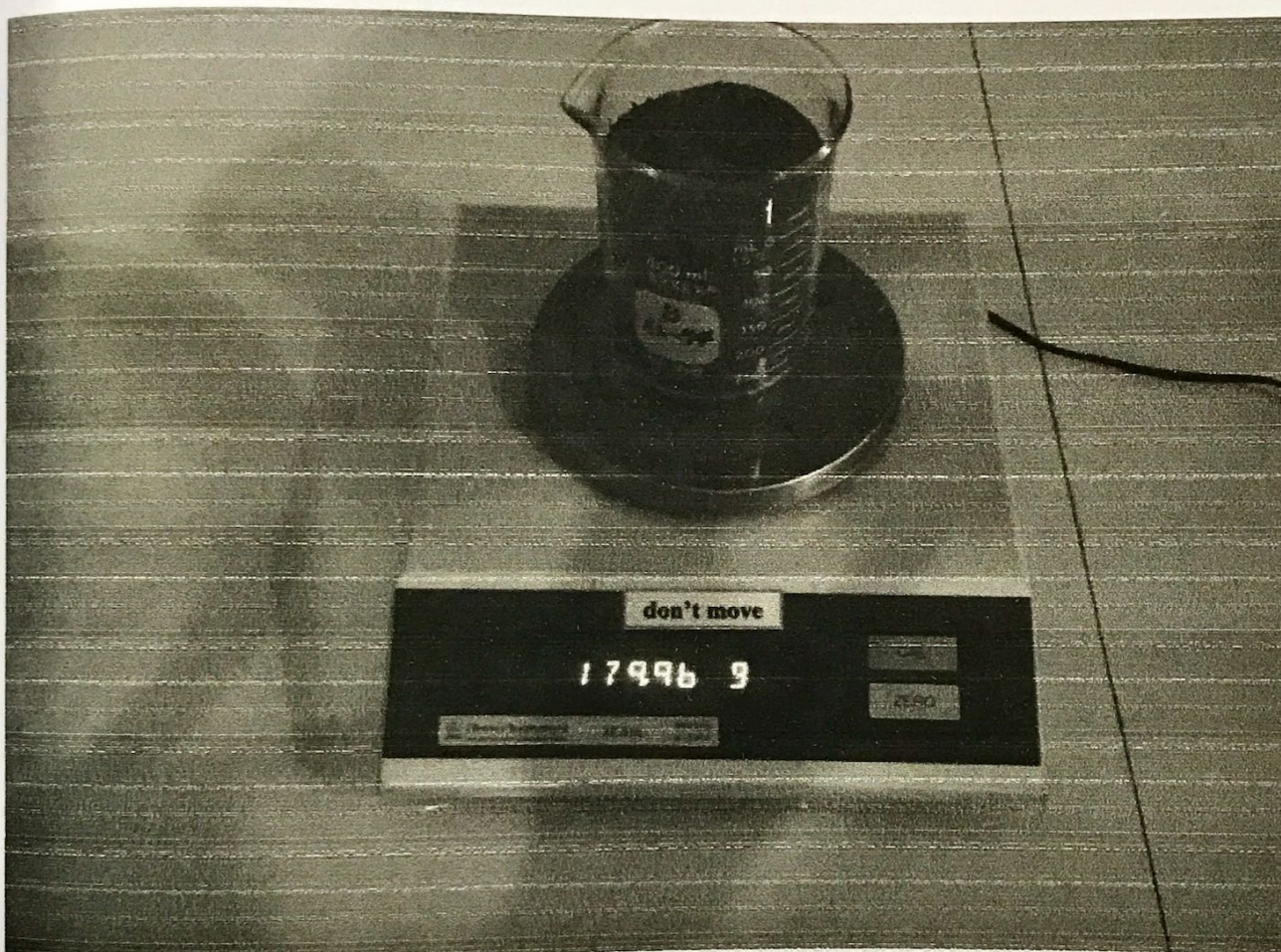


Plate 11: Constant weighing of cocopeat made from Macapuno.



Plate 12: Cocopeat-Water set-up: used in measuring the three properties in this study.

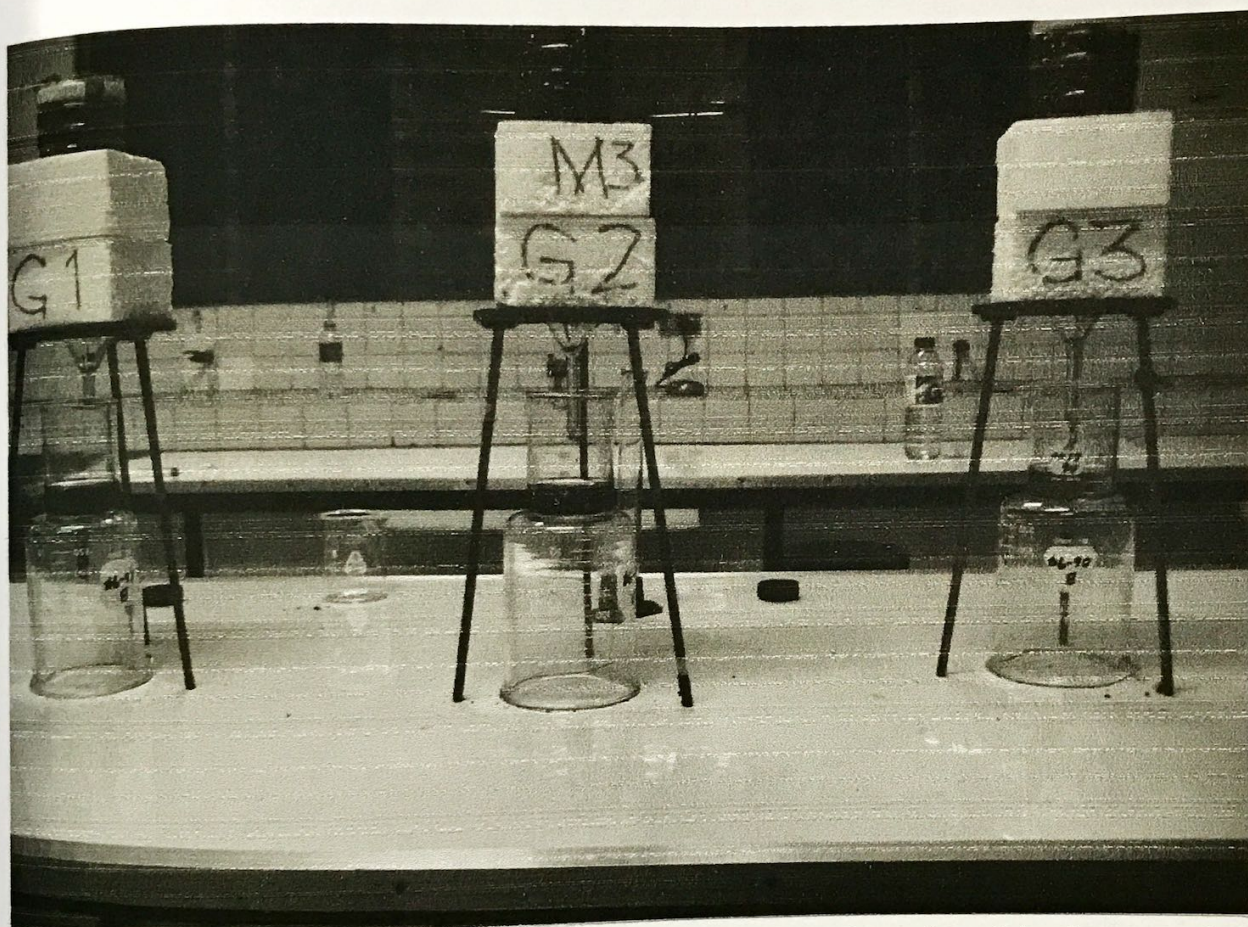


Plate 13: Measurement of the water holding capacity, porosity and aeration of the three samples of cocopeat made from golden coconuts.

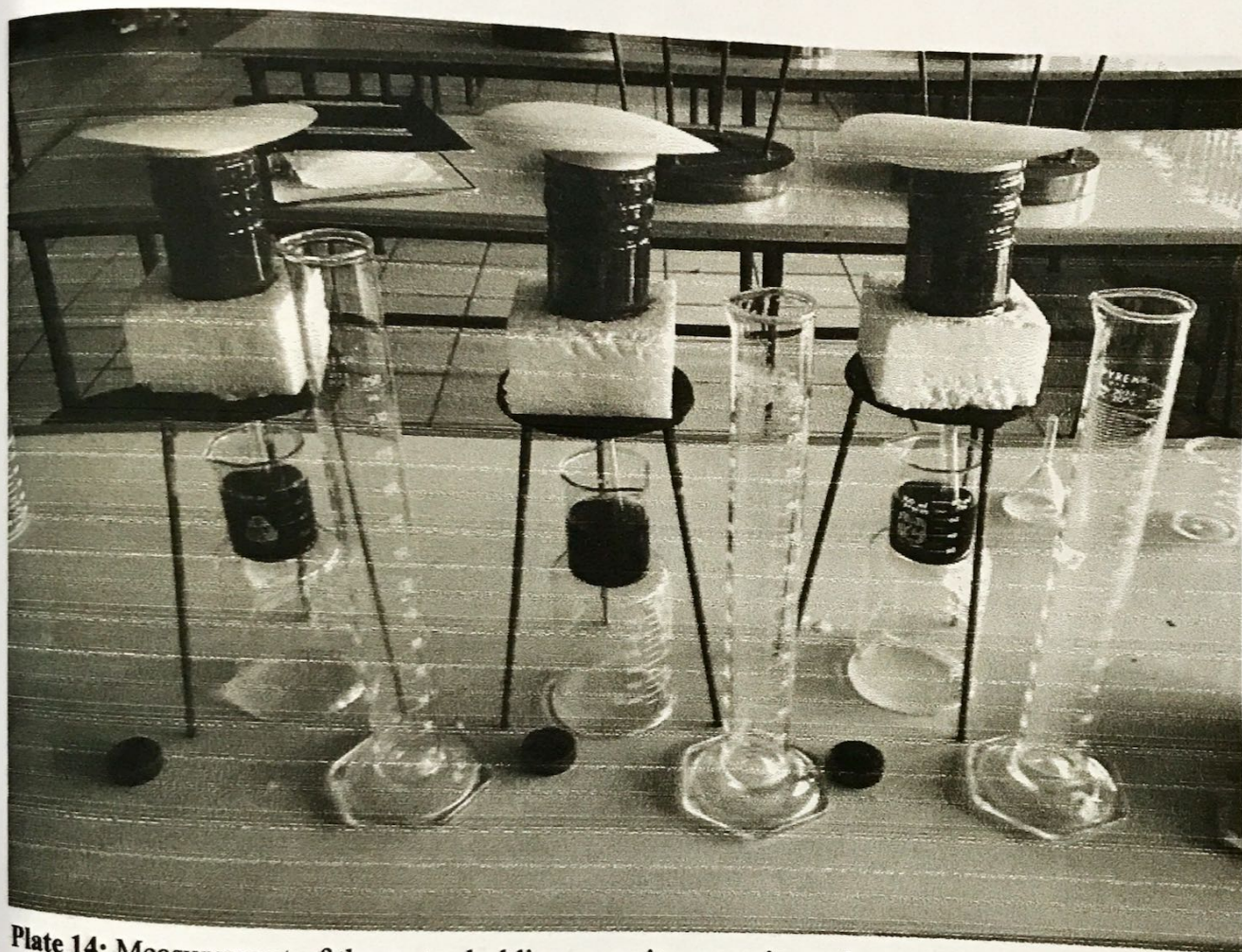


Plate 14: Measurement of the water holding capacity, porosity and aeration of the three samples of cocopeat made from native coconuts (*Cocos Nucifera*).

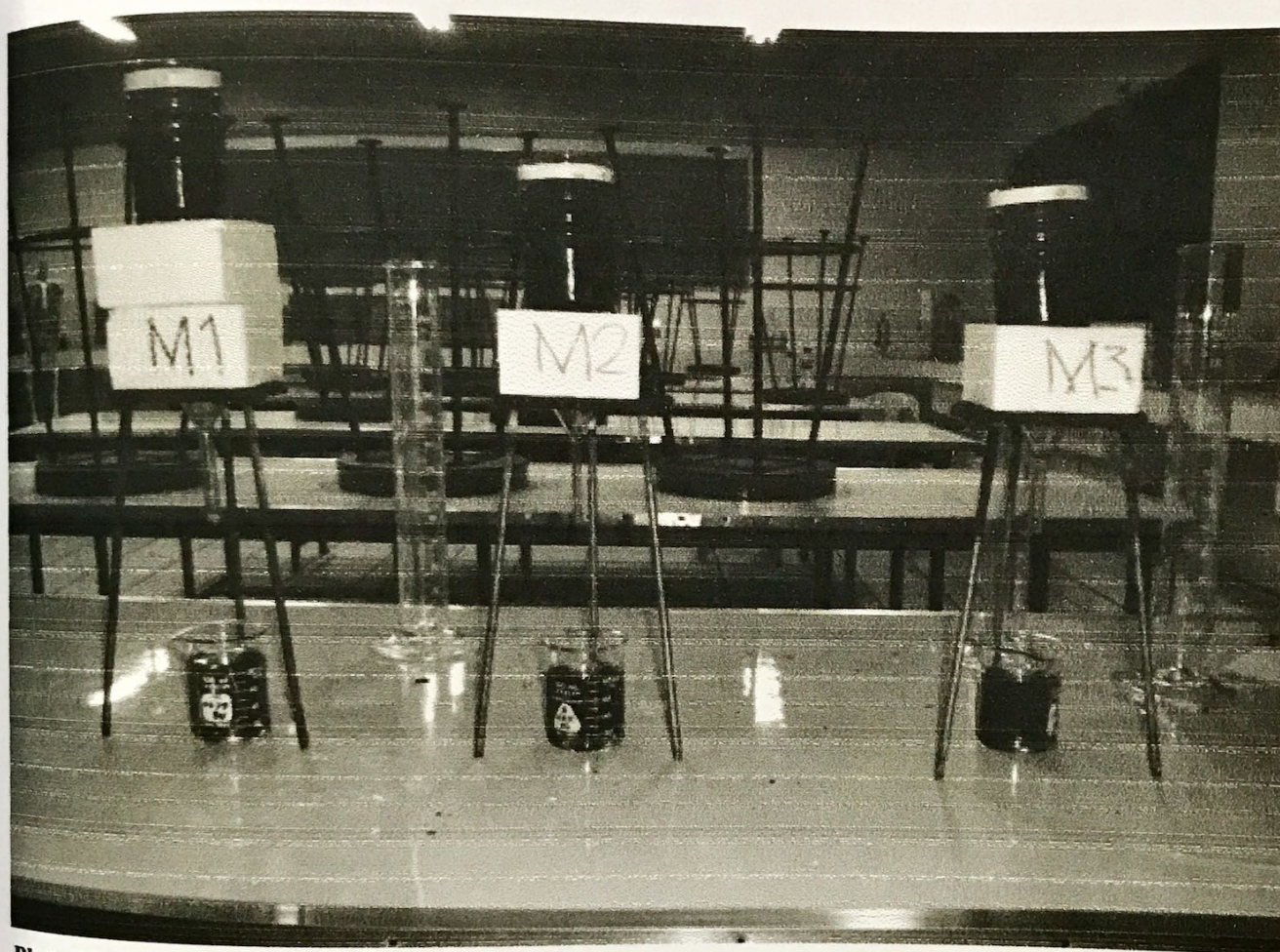


Plate 15: Measurement of the water holding capacity, porosity and aeration of the three samples of cocopeat made from Macapuno.

APPENDIX A

RAW DATA FOR CONSTANT WEIGHING

Table Cocaine

Sample	1 st	2 nd	3 rd	4 th
178.41 grams	177.92 grams	177.84 grams	177.85 grams	
169.56 grams	169.35 grams	169.37 grams	169.36 grams	
194.83 grams	194.38 grams	194.39 grams	194.28 grams	

Table Cocaine

Sample	1 st	2 nd	3 rd	4 th
179.36 grams	179.96 grams	179.88 grams	179.87 grams	
174.52 grams	174.14 grams	173.99 grams	173.98 grams	
182.33 grams	182.03 grams	181.92 grams	181.91 grams	

Table Cocaine

Sample	1 st	2 nd	3 rd
184.50 grams	183.56 grams	183.53 grams	
181.92 grams	181.10 grams	181.07 grams	
184.57 grams	183.83 grams	182.79 grams	

LIST OF APPENDICES

APPENDIX A

RAW DATA FOR CONSTANT WEIGHING

Native Coconuts

1 st Sample			
1 st	2 nd	3 rd	4 th
178.41 grams	177.92 grams	177.84 grams	177.85 grams
2 nd Sample			
1 st	2 nd	3 rd	4 th
169.96 grams	169.35 grams	169.27 grams	169.26 grams
3 rd Sample			
1 st	2 nd	3 rd	4 th
194.83 grams	194.38 grams	194.29 grams	194.28 grams

Macapuno

1 st Sample			
1 st	2 nd	3 rd	4 th
180.36 grams	179.96 grams	179.88 grams	179.87 grams
2 nd Sample			
1 st	2 nd	3 rd	4 th
174.52 grams	174.14 grams	173.99 grams	173.98 grams
3 rd Sample			
1 st	2 nd	3 rd	4 th
182.33 grams	182.03 grams	181.92 grams	181.91 grams

Golden Coconuts

1 st Sample		
1 st	2 nd	3 rd
184.50 grams	183.56 grams	183.58 grams
2 nd Sample		
1 st	2 nd	3 rd
181.92 grams	181.10 grams	181.07 grams
3 rd Sample		
1 st	2 nd	3 rd
184.57 grams	183.80 grams	183.79 grams

APPENDIX B

RAW DATA FOR THE MEASUREMENT OF THE POROSITY, AERATION AND WATER HOLDING CAPACITY

Coconut Variety		Properties		
		Porosity (%)	Aeration (%)	Water Holding Capacity (%)
Native Coconuts	A	94.40	28.20	65.60
	B	92.00	26.40	65.60
	C	93.60	25.60	68.00
Macapuno	A	86.40	33.60	52.80
	B	82.40	31.20	51.20
	C	89.20	30.40	58.80
Golden Coconuts	A	81.60	28.40	53.20
	B	81.60	30.40	51.20
	C	83.20	29.60	53.60

APPENDIX C

RAW DATA FOR THE CONTAINER VOLUME, AERATION PORE VOLUME AND PORE VOLUME

Coconut Variety		Properties		
		Container Volume (mL)	Pore Volume (mL)	Aeration Pore Volume (mL)
Native Coconuts	A	250	236	72
	B	250	230	66
	C	250	234	64
Macapuno	A	250	216	84
	B	250	206	78
	C	250	223	76
Golden Coconuts	A	250	204	71
	B	250	204	76
	C	250	208	74

RAW DATA FOR TUKEY'S TEST FOR WATER HOLDING CAPACITY

Tukey's Multiple Comparison Test	Mean Diff	q	Significant? P < 0.05?	95% CI of diff
Water Holding Capacity (M) vs Water Holding Capacity (GC)	12.13	8.216	Yes	5.726 to 18.54
Water Holding Capacity (M) vs Water Holding Capacity (GC)	13.75	9.300	Yes	7.326 to 20.14
Water Holding Capacity (M) vs Water Holding Capacity (GC)	1.608	1.043	No	-4.808 to 8.008

APPENDIX D

RAW DATA FOR TUKEY'S TEST FOR POROSITY

Tukey's Multiple Comparison Test	Mean Diff.	q	Significant? P < 0.05?	95% CI of diff
Porosity (NC) vs Porosity (M)	7.333	5.874	Yes	1.917 to 12.75
Porosity (NC) vs Porosity (GC)	11.20	8.971	Yes	5.783 to 16.62
Porosity (M) vs Porosity (GC)	3.867	3.097	No	-1.550 to 9.284

RAW DATA FOR TUKEY'S TEST FOR AERATION

Tukey's Multiple Comparison Test	Mean Diff.	q	Significant? P < 0.05?	95% CI of diff
Aeration (NC) vs Aeration (M)	-5.000	6.361	Yes	-8.410 to -1.590
Aeration (NC) vs Aeration (GC)	-2.733	3.478	No	-6.144 to 0.6771
Aeration (M) vs Aeration (GC)	2.267	2.884	No	-1.144 to 5.677

RAW DATA FOR TUKEY'S TEST FOR WATER HOLDING CAPACITY

Tukey's Multiple Comparison Test	Mean Diff.	q	Significant? P < 0.05?	95% CI of diff
Water Holding Capacity (NC) vs Water Holding Capacity (M)	12.13	8.216	Yes	5.726 to 18.54
Water Holding Capacity (NC) vs Water Holding Capacity (GC)	13.73	9.300	Yes	7.326 to 20.14
Water Holding Capacity (M) vs Water Holding Capacity (GC)	1.600	1.083	No	-4.808 to 8.008