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**Effectivity of Avocado (*Persea americana*) Peels as Rust Remover in Metals**

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## **ABSTRACT**

Rusting causes iron to become flaky and weak, degrading its strength, appearance, and permeability. This study aims to test if the oxalic acid in Avocado (*Persea americana*) peels is capable of removing rust at different severity. The output of this study will be significant to common households and parties who work with metal, as this study will help them find a partial solution to rust removal. The researchers used an experimental set-up research design to analyze the capability of avocado peels to remove rust. There is one independent variable under this experimentation which is the oxalates found in avocado peels while the effect of the oxalic acid on the rust is the dependent variable. The avocado peels have oxalic acid that completely removes rust from newly tarnished metal however it can only moderately remove rust from severely tarnished metals. The study concluded that avocado peels are effective in removing rust depending on its severity. The researchers recommend to future researchers use ripe or overripe avocado and prolong the experiment time. To the government to expand studies in producing organic products such as avocado peel rust remover to be used by households and in their government projects to lessen the cost and damage to infrastructures and household materials and also to help in the environment's healing.

Keywords: *corrosion, oxalic acid, exocarp, avocado peels*

## **CHAPTER 1**

### **INTRODUCTION**

#### **Background of the Study**

Rusting causes iron to become flaky and weak, degrading its strength, appearance, and permeability. Rusted iron does not hold the desirable properties of iron. The rusting of iron can lead to damage to automobiles, railings, grills, and many other iron structures. The collapse of the Silver Bridge in 1967 and the Mianus River bridge in 1983 is attributed to the corrosion of the steel/iron components of the bridge. Many buildings made up of reinforced concrete also undergo structural failures over long periods of time due to rusting. Rusted iron can be a breeding ground for bacteria that cause tetanus. Cuts from these objects that pierce the skin can be dangerous. Since rusting occurs at an accelerated rate in humid conditions, the insides of water pipes and tanks are susceptible to it. This causes the pipes to carry brown or black water containing an unsafe amount of iron oxides (BYJU'S, 2019).

The Philippines' iconic and only all-steel church, which dates back to 1891, is starting to show its age, and corrosion is causing major concerns. While the exterior of the Basilica Menor de San Sebastian, better known as San Sebastian Church, in Manila receives a regular paint job, water leaks are corroding critical sections of the Gothic structure. The church's team had identified and repaired the five most damaged supporting columns with metal plates that were partially eaten away by corrosion (environmental cracking also known as *rusting*) and contained up to two meters of water (Union of Catholic Asian News, 2017).

Recently, last January 21, 2022, a survey was conducted by one of the researchers at purok Lorenzo Poblacion, Barangay Pangyan. The observational survey results showed that four (4) out of ten (10) households are dealing with rust or corrosion in that certain area. Furthermore, an observation was made that there are old bridges in the local area of Tugbok, specifically the Callawa Hanging Bridge which is totally covered with rust.

Rust is the common name for chemicals that result when iron reacts with oxygen and water (reliance-foundry, 2018). The most familiar form of rust is the reddish coating that forms flakes on iron and steel ( $\text{Fe}_2\text{O}_3$ ) (Helmnstine, A., 2020). Rust is formed when iron or an alloy of iron is exposed to oxygen in the presence of moisture (geeksforgeeks.org, 2022). When steel is exposed to water, the iron particles are lost to the water's acidic electrolytes. This phenomenon is a great example of the corrosion of metals, where the surfaces of metals are degraded into more chemically stable oxides. However, the term 'rusting' is generally used to refer to the corrosion of objects made of iron or iron alloys. This reaction is not instantaneous; it generally proceeds over a considerably large time frame. The bonding between oxygen atoms and iron atoms weakens the bonds between the iron atoms in the object/structure. The reaction of the rusting of iron involves an increase in the oxidation state of iron, accompanied by a loss of electrons (BYJU'S, 2019).

The use of avocado (*Persea americana*) is focused in this study. Oxalic acid is widely used as an acid rinse in laundries, where it is effective in removing rust and ink stains because it converts most insoluble iron compounds into a soluble complex ion (Encyclopedia Britannica, 2018). The researchers are now focused on the use of oxalic acid found in avocados as a potential organic rust remover to prevent iron from being replaced with red powdery rust that causes the weakening of metal and spreading further damage to properties.

## **Hypothesis**

$H_1$ : If the oxalic acid present in avocado peels can remove the rust on the metal then the avocado peel is an effective rust remover agent.

$H_2$ : If the oxalic acid present in avocado peels cannot remove the rust on the metal then the avocado peel is not an effective rust remover agent.

## **Significance of the Study**

This study can contribute to households as a substitute to costly rust removers. To the government's projects to minimize accidents and damages caused by rusting in infrastructures and to the future researchers to broaden knowledge about the organic properties of avocado (*Persea americana*) or other organic fruit not just as a nutrient source of the human body but that will probably lead to the use of a natural-made rust remover that is easily found in our environment.

## **Scope and Limitation**

The researchers conducted this research to test the effectiveness of oxalic acid in the avocado peels that may remove the rusting on metals. However, the study has its limitations; the type of metals used and insufficient experimentation time caused by lack of consideration.

## **Definition of Terms**

The following terms are operationally defined to provide a common understanding in this investigatory project.

**Mesocarp** - refers to the middle layer of a fruit

**Exocarp** - refers to the outermost layer of the fruit

**Rust** -the reddish brittle coating formed on iron especially when chemically attacked by moist air and composed essentially of hydrated ferric oxide.

**Corrosion** -the action, process, or effect of corroding.

**Tarnish** - to dull or destroy the luster of by or as if by air, dust or dirt.

**Oxalic Acid** - an acid that occurs in various plants as oxalates and is used especially as a bleaching or cleaning agent and as a chemical intermediate.

## CHAPTER 2

### METHODOLOGY

This chapter of this Science Investigatory Project (SIP) shows the research design and procedures of the experiment. There is one independent variable under this experimentation which is the oxalates found in avocado peels. The effect of the oxalic acid on the rust is the dependent variable.

The investigation involves 5 phases namely: Phase I – Preparation of the avocado peels, Phase II – Gathering of rusted metals, Phase III – Application of avocado peels to the rust, Phase IV – Evaluating the efficacy through observation, and Phase V – Proper disposal.

The materials used in the experiment are: cutting board, knife, plate, spoon, timer, avocados, and the metal set-up.

#### **PHASE I – Preparation of the Avocado peel.**

The avocado is bought from a local fruit stand in Calinan Poblacion. The avocados will be gently washed thoroughly using tap water and sliced in half. The mesocarp and seed of the avocado will be scooped out, leaving the avocado's exocarp.



## **PHASE II – Gathering of rusted metals.**

The rusted metals will be provided by one of the researchers. These metals will be categorized in three set-ups, namely; Set-up A (completely tarnished metal), Set-up B (moderately tarnished metal), Set-up C (mildly tarnished metal) and Set-up D (newly tarnished metal).



*(Set-up A, Set-up B, Set-up C, and Set-up D, from left to right)*

## **PHASE III – Application of Avocado peels to the metal rust**

The avocado peels will be applied to the surface of the metal through rubbing for thirty seconds. The metals will be set aside for 10 minutes; and will be evaluated through observation.



#### **PHASE IV – Evaluating the effect of avocado peels through observation.**

After 10 minutes, the metals will be wiped with a clean cloth; each set-up will be observed for any physical changes. This process will be repeated for Trial 2. The results will be shown in a table.

#### **PHASE V – Proper Disposal.**

After the experiment, the researchers will dispose of the avocado peels in a compost pit. The metals will be sold or given to a junk shop.

## CHAPTER 3

### RESULTS AND DISCUSSION

The following are the results of the metal's physical changes when rubbed with avocado (*Persea americana*) peels. Strict implementation of sanitation has been observed throughout the experiment. The researchers made sure to wash their hands thoroughly with warm water and soap before and after the experiment, the knife and spoon used in the experiment were sterilized with hot water before and after the experimentation.

*Table 1. Tarnished Metals Under Experimentation*

Set-Ups	Tarnished Metal Before Experimented with the Avocado's Exocarp	Trial 1	Trial 2
Set-up A (Completely Tarnished Metal)			
Set-up B (Moderately Tarnished Metal)			
Set-up C (Mildly Tarnished Metal)			

Set-up D (Newly Tarnished Metal)			N/A
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The rust in Set-up D was completely removed after 1 trial, therefore, no second trial was conducted for the experiment. For Set-up A, the completely tarnished metal, there were hardly any physical changes other than small quantity of flakes coming off. In Set-up B, the moderately tarnished metal, there is also no noticeable changes observed. Lastly, in Set-up C, there is little to no physical changes observed. Do note that all sides of the metal were thoroughly wiped lightly with avocado peels for all trials.

## **CHAPTER 4**

### **CONCLUSION AND RECOMMENDATION**

#### **Conclusion**

Based on the results, avocado (*Persea americana*) peels can remove newly formed rust, whereas it cannot remove rust from metals that have been tarnished for a long period of time. Factors such as the heavy rusting of the metals caused by air and chemical exposure after a long period of time led to the failure of removing the rust in Trials 1 and 2 in set-ups A, B, and C. The newly formed iron oxide on Set-up D, however, was easily removed; the researchers concluded that the effectiveness of oxalates found in avocado (*Persea americana*) peels depend on the severity of the rust. The reason behind the easy removal of the newly formed rust is due to the lack of adherence of the oxide on metals (Reliance Foundry, 2019).

#### **Recommendation**

The researchers recommend to the future researchers to use overripe avocados, consider using other varieties of avocado, and lengthen the experimentation time. To the government to expand studies in producing organic products such as avocado peel rust remover to be used by government projects to lessen the cost and damage to infrastructures and also for the household materials as well as to help in the environment's healing.

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