

# Insecticidal Property of Jackfruit (*Artocarpus heterophyllus*) Peel Ethanol Extract against Rice Weevils (*Sitophilus oryzae*)

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**Abstract:** Insects are known as pests at home which can lower the quality of food for human. There are insects that destroy the quality of farm harvest, thereby decreasing its palatability and marketability. One of the very well-known insects pests is the rice weevils (*Sitophilus oryzae*) which damages the quality of rice grain and lowers its market value. This study seeks to find out what concentration of Jackfruit Peel Ethanol Extract (JPEE) will give the highest mortality in 1.2 hours of observation. Experimental research method with four treatments, and twenty (rice weevils) samples/treatment, was used to gather pertinent data on this study. Jackfruit Peel was oven dried, grounded, macerated in 70% ethanol for 3 days and subjected to rotary evaporation. Different concentrations of Jackfruit Peel ethanol extract, (JPEE) was done. T- (control), 0% JPEE, T<sub>1</sub>, 25% JPEE, T<sub>2</sub>, 50% JPEE and T<sub>3</sub>, 75% JPEE. Data on mortality for 1.2 hours with 20 minutes interval, was analyzed using Analysis of Variance and Fisher Least Significant Difference (LSD) Test as post hoc Test. Result revealed significant difference on the means of four treatments. It is imperative that rice weevils in T<sub>3</sub> (750% of Jackfruit Peel Ethanol Extract) gave highest mortality in 1.2 hours, when exposed to JPEE. ANOVA revealed significant difference at 5% level of significance. Fisher LSD showed significant difference on control and treatments with JPEE. No significant differences exist among treatment with JPEE, which implies that any of the three treatment with JPEE can control rice weevils at 1.2 hours of observation. It shows that JPEE is a potential source of insecticide particularly for rice weevils.

**Key words:** Jackfruit peel, rice weevils, (*Sitophilus oryzae*).

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## 1. Introduction

Rice is the main energy source for Filipinos. Most farmers grow rice in their farm to supply the staple food for the entire populace. Philippines being tropical, favor the existence of insect pests not only in their farm but even on their post-harvest facilities like rice granary. In the early weeks of September 2018, about 132,400 bags of rice from Thailand and Vietnam that were unloaded in Subic port Philippines were found infested with weevils or “bukbok.” The heat inside the ship became conducive to the hatching of weevil eggs [1]. Indigenous plant base environment friendly insecticide are now gaining popular than commercial insecticide. Insect pest like weevil destroys rice grains in storage areas causing decrease in quality and palatability. The rice weevil, (*Sitophilus oryzae*) belongs to order Coleoptera and family Curculionide. Adult is small (2.5 to 4 mm), dark brown. It has chewing mouthparts at the end of their snouts or prolonged heads, and is about 1/8- to 3/16-inch long, depending on the size of the grain kernel. The adult rice weevil is a dull

reddish-brown with round or irregularly shaped pits on the thorax and four light spots on the wing covers. Adult rice weevils live for four to five months and each female lays 300 to 400 eggs during this period. The female uses her strong mandibles to chew a hole in the grain kernel where she deposits a single egg and seals the hole with a gelatinous fluid. Damage to grain caused by this weevil includes reductions in nutritional value, germination, weight and commercial value [2]. The use of insecticide from herbal plants in lieu of synthetic insecticide is becoming popular in the market. It will not harm the environment and will maximize the use of herbal plants in the locality.

Jackfruit is a tropical fruit that is very popular among Filipinos. Its flesh or fruit pods, are edible both when ripe and unripe. When unripe, Filipinos cook it with coconut milk and dried fish or shrimp, as one of vegetable in their viand. The aromatic fruit when ripe can be eaten as raw or as one of the ingredients in many Filipino delicacies. However the peel are just thrown away after the removal of the fruit pod. Ethanolic and methanolic extracts of Jackfruit peels contain phytochemicals as revealed in the phytochemical screening. The presence of alkaloids, flavonoids, carbohydrates, proteins and triterpenoids are the active compounds in the screening done. The Gas Chromatography-Mass Spectroscopic analysis of various extracts like ethanol and methanol identified the presence of various phytochemical compounds and secondary metabolites like Hexadecanoic acid, Squalene, Calophyllolide, Thialisopyine and so on. Nuclear Mass Resonance Spectroscopy showed the presence of Alkyl group and carbon bearing OH group compounds. Atomic Absorption Spectroscopy of peel indicated the presence of major minerals like calcium, potassium and other minor minerals. All these findings implied the availability of various active and phytochemical compounds and also some minerals from the peel [3]. The peel extract exhibited the highest total phenolic and total flavonoid content, and the phenolics was 4.65, 4.12 and 4.95 times higher than that of pulp, flake and seed extract, respectively. The strongest DPPH and ABTS+ scavenging ability,  $\alpha$ -glucosidase inhibition were also found in peel extract, and the  $\alpha$ -glucosidase inhibition was about 11.8-fold of that of acarbose. The HPLC-QTOF-MS/MS analysis led to the tentative identification of 53 compounds, prenylflavonoids, hydroxycinnamic acids and glycosides are the predominant bioactive compounds [4]. The pulp of ripe fruit, contains doubled amount of gallic acid (19.31  $\mu\text{g/g}$ ) than the unripe peel, while ferulic acid (2.66  $\mu\text{g/g}$ ) was drastically reduced. Tannic acid (5.24  $\mu\text{g/g}$ ) increased as compared to raw pulp of fruit skin [5]. Tannins are bitter-tasting phenolic compounds found in flowering woody plants like jackfruit and use it as defense against its predators.

No published study on the use of jackfruit peel, as insecticide, hence this study. This study was conducted mainly to investigate the insecticidal potential of Jackfruit peel against rice weevil. The result of this study is beneficial, to partner communities of San Beda University-Institutional Community Engagement Center, where rice farming and selling is the main source of livelihood. Specifically this study answers the following research questions:

- 1) What is the mortality of rice weevils in different concentrations of Jackfruit Peel seeds Ethanol extract (JPEE) every 20 minutes observation, for 1.2 hours?
- 2) What is the behaviour of rice weevils in different concentration of Jackfruit Peel Ethanol extract (JPEE) every 20 minutes observation?
- 3) Is there a significant difference on the mortality of rice weevils in different concentrations of Jackfruit Peel Ethanol extract (JPEE) every 20 minutes of observation.

## **2. Methodology**

### **2.1. Preparation of Jackfruit Peel Ethanol Extract (JPEE)**

The method of JPEE preparation was patterned from several studies with slight modification. Peel of ripe

Jackfruit were oven dried at 100 °C [6] (Fig. 1a). When the peel is already crispy it was grounded in a mechanical grinder [7] (Fig. 1b). Ground jackfruit peel was macerated to solvent (70% Ethanol), following the ratio of 1:4 w/v [8]. Maceration was done for 3 days with constant agitation (Fig. 2). The mixture was filtered with the use of cheese cloth and Whatman paper no. 1, and was subjected to rotary evaporation to remove the ethanol (Fig. 3).



Fig. 1 a. Jackfruit peel in the oven.



Fig. 1 b. Grounded jackfruit peel.



Fig. 2. Maceration of JPEE.



Fig. 3. JPEE in rotary evaporator.

## 2.2. Application of JPEE/Exposure Technique

Force-feeding tests was conducted following the procedures adopted by several insecticidal studies using herbal extracts with slight modifications, [9]-[14]. Four pairs of sterilized petri dishes (dia. 5.5 cm) were used. JPEE was diluted in distilled water, in different concentrations as follows; T1, 25% JPEE, T2, 50% JPEE, and T3, 75% JPEE (Fig. 4). Each filter paper in the bottom of petri dish was fully absorbed with JPEE (Fig. 5).

Infusion was carried out using a syringe. For each concentration a new syringe was used. Distilled water was used for control (T-). Twenty live rice weevils were subsequently introduced in each petri dish, after which the insects were touched at the abdomen using glass rod to determine its mobility. Each treatment has 20 rice weevils. Data for the mortality of the rice weevils was recorded every 20 minutes for one hour and 20 minutes [15].



Fig. 4. JPEE in different concentrations.



Fig. 5. JPEE in Petri dishes.

### 2.3. Data Analysis

Data on mortality was analyzed using Analysis of Variance (ANOVA) and Fisher Least Significant Difference Test as post hoc test.

## 3. Results and Discussion

### 3.1. Number of Rice Weevils, per Treatment on the Start of the Study

Number of live rice weevils per treatment is shown in Table 1. To ensure uniformity and avoid bias in the result on the controlled variables, twenty live rice weevils were obtained from the same sack of rice from the stockroom of a rice trader in Palanan, Makati City Philippines. It was collected from an infested sack of rice in the “bodega” which was characterized by off odour and low quality of rice.

Table 1. Number of Rice Weevils per Treatment on the Start of the Study

Treatment	-	1	2	3
Number of rice weevils	20	20	20	20
Mean	20	20	20	20

### 3.2. Mortality of Rice Weevils per Treatment for 1.5 Hours Observation

Mortality in this study is described as non-motility of rice weevils even if touch by glass rod on their abdominal part. Table 2 posited the mortality per treatment every 20 minutes of observation. Highest mortality was observed in treatment 3, 100% mortality, followed by T<sub>2</sub>, 80% mortality and T<sub>1</sub>, with 75% mortality. No mortality was observed in T- (control). Result revealed that increasing the percentage of SSEE also increases mortality. Fig. 6 displays the percentage of mortality per treatment in graph, which denotes that T<sub>3</sub> had the highest mortality even in 1.2 hours of observation. Table 2 revealed highest percentage of mortality in T<sub>3</sub>, 75% JPEE) at 1.2 hours observation. Table 3 (ANOVA) revealed significant differences among the four treatments. Significant differences exist between pairs of means with different superscripts as revealed by Fisher LSD (T- vs T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>). The result further implies that 25% to 75% of JPEE caused death/mortality of the rice weevils in 1.2 hours.. The mortality of the rice weevils may have resulted from

the biocidal effects of the plants which contains active components [16].

Several studies can attest to the claims of this study. Crude plant extracts causes toxicity [17]. and feeding inhibition of insects [18]. Jackfruit has a multifaceted properties like antiasthmatic, antioxidant, antibacterial, antifungal, anticancer, hypoglycemic, antimalarial, antidiarrheal, antiarthritic, anthelmintic, anti-inflammatory, antiplatelets, antiviral, and show wound healing effect [19]. The presence of flavonoids in jackfruit peel is one the possible causes of its mortality. The effects of higher doses of flavonoids in insects alter normal body functions. The presence of these phytochemical alters some biochemical functions of organisms. The effects of flavonoids on the transhydrogenation, NADH oxidase, and succinate dehydrogenase reactions suggest that compounds of this nature may prove valuable in the control of insect populations by affecting mitochondrial enzyme components [20].

Table 2. Mortality per Treatment Every Fifteen Minutes of Observation

Treatment	-	1	2	3
First 20 minutes	0	2	3	4
Second 20 minutes	0	5	9	12
Third 20 minutes	0	4	3	4
Fourth 20 minutes	0	3	2	2
Total	0	14	17	20
Mean	0 <sup>a</sup>	3.5 <sup>be</sup>	4.25 <sup>ce</sup>	5.5 <sup>de</sup>
% of mortality	0	70	85	100

Table 3. Analysis of Variance (ANOVA)

ANOVA						
S.V.	SS	df	MS	F	P-value	F crit
Rows	56.18	3	18.72	4.37 <sup>*</sup>	0.036	3.86
Columns	66.68	3	22.22	5.18 <sup>*</sup>	0.023	3.86
Error	38.56	9	4.28			
Total	161.4375	15				

Legend: \* significant at 5% level of significance

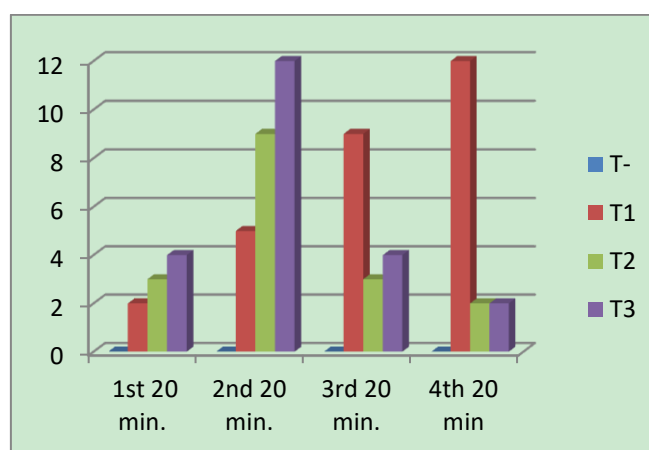


Fig. 6. Percentage of mortality per treatment.

### 3.3. Behaviour of Rice Weevils every 15 Minutes of Observation

Table 4 summarized the behaviour of rice weevils per treatment. On the first 20 minutes, experimental insects are lethargic /weak. Most of the insects stay on the sides of petri dish and evaded the JPPE area

(Fig. 7). Insects will tend to evade areas with pungent odor and with tannin content [21]. On the 2<sup>nd</sup> 20 minutes, insects lie on their back and the legs are still moving. On the third 3<sup>rd</sup> 20 minutes, remaining insects were totally weak, paralyzed, but still moving if touch by glass rod in their abdomen. Rice weevils in negative control (T-) were all active.

It can be gleaned from Table 4 that rice weevils were affected by the biochemical components of JPEE. Tannin enters the epidermal tissues of insects and causes off-feeding of insects thereby affecting its body movements. The conspicuous/abrupt change in their locomotion is characterized by weakness as early as 20 minutes of exposure to JPEE. After 40 minutes of exposure, paralysis was observed in treatments with SSEE. Touching the abdominal regions of the rice weevils, with glass rod indicates that they are still alive, by movement of the legs even if the insects lie on their back. Paralysis of the entire body except the limbs is as indication that the physiologic functions were already disturbed. Tannin present in jackfruit peel is characterized by astringent, bitter plant polyphenols that either bind and precipitate or shrink proteins. The astringency from the tannins causes the dry and puckery feeling in the mouth following the consumption of red wine, strong tea, or an unripened fruit [22]. Tannins are astringent (mouth puckering) bitter polyphenols and act as feeding deterrents to many insect pests [23]. With the highest mortality in T<sub>3</sub>, it is imperative that jackfruit peel can be used as insecticide (rice weevil). Studies on the use of jackfruit peel in different concentrations shall be explored on other insect pests.

Table 4. Behavior of Rice Weevils for 1.2 Hours Observation

Treatment	-	I	2	3
First 20 minutes	active	weak	weak	weak
Second 20 minutes	active	Lie on their back	Lie on their back	Lie on their back
Third 20 minutes	active	paralyzed	paralyzed	paralyzed
Fourth 20 minutes	active	paralyzed	paralyzed	paralyzed

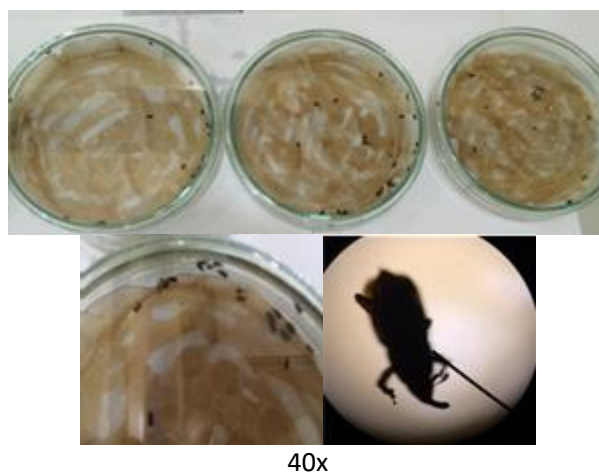


Fig. 7. Rice weevils moved to JPEE free area.

#### 4. Conclusion

Insect Pests of rice like rice weevils needs to be treated with chemicals that are less potent to human. These chemicals need to be originated from plants. Jackfruit peels are just thrown away, after consumption of the fruit pod. This study revealed significant result when jackfruit peel was macerated in 70% ethanol and administered to rice weevils in different concentrations (25%, 50% and 75%). The use of JPEE from 25% to 75% yielded mortality as early as 20 minutes observation, but it is more potent at 40 minutes exposure of rice weevils in JPEE. It is imperative that jackfruit peel can be used as insecticide (rice weevils). Studies on the use of JPEE in different concentrations shall be explored on other insect pests.



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