The Influence of the Ethanol Extracts of Numerous Plants on the Development and Efficiency of the Nourishment Intake of the Fifth Instar Larvae of Heliothis Armigera Hubner

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Abstract: A study has been conducted on the impact of ethanol extract from various plants of Sweet orange peel (Citrus sinensis), Mexican Sunflower (Tithonia diversifolia), Ginger rhizome (Zingiber officinale), and Lemongrass (Cymbopogon citratus) on the development and efficiency of diet utilization of fifth instar larvae of H. Armigera. The research implemented the Complete Randomized Designed (CRD) using the treatment concentrations of (0,00%, 0.25%, 0,50%, 1,00%, 2,00%, 4.00%) and iteration of fifteen larvae. The observation data were analyzed by variance if there were differences then followed by DnMRt test of 5%. The results showed that all treatment concentrations could reduce growth; Relative Growth Rate (RGR) and efficiency of diet utilization, i.e., relative consumption rate (RCR), Efficiency of conversion of ingested diet (ECI), Efficiency of conversion of the digestive nourishment (ECD). On contrary, there is an increase in the Approximate Digestibility (AD) value, and statistically, the control is varied as the treatment concentrations of 1.00% - 4.00% for (RCR, RGR, AD) and the treatment concentrations 0.50% of to 4.00% set for (ECI, ECD). Overall, the effective concentration that affects the growth rate and the efficiency of food consumption of A. armigera larvae is at a concentration of 2.00%.

1 INTRODUCTION

In an effort to control plant pests, the high frequency usage of synthetic insecticides and arbitrary application of the insecticides will result in tremendous negative impacts such as resistance and resurgence, killing of useful organisms, environmental pollution, and insecticide residues that are very harmful to human health because it can cause cancer, kidney damage, genetic mutations, many more (Harborne, 1987). The high residual content can also weaken the selling value of the vegetable commodities, primarily for export purposes since vegetables with a residual content above the threshold will be rejected by the importing country, so it is very detrimental to the economic sector (Grainge and Ahmed, 1988).

For this reason, the government is keen to socialize how significant the impact of the loss of synthetic insecticide use, with the hope that the farmers as the producers are expected to fulfill these demands, including conducting organic farming, because in organic farming pest control must be based on plant insecticides. The government recommends the organic pesticides due to its nature, including biodegradable, selectivity (relatively safe against natural enemies of the pest), compatibility (can be combined with other pest control components), can slow down the resistance rate, and ensure resilience and sustainability in farming (Rattan, 2010).

In Tanah Karo, horticultural farmers use botanical insecticides from several types of plants to control pests in organic farming systems, including: sweet orange peel (C. sinensis), Mexican sunflower (T. diversifolia), ginger rhizome (Z. officinale), and lemongrass (C. citratus) that have potential as botanical insecticides (Harborne, 1987).

Tthe use of plant-based insecticides by farmers in Tanah Karo must be examined to attract Tanah Karo farmers to work with the organic farming system. The evaluation was performed by searching for secondary metabolites, the concentration of ethanol extract from the organic insecticides of sweet orange peel (C. sinensis), Mexican sunflower (T. diversifolia), ginger rhizome (Z. officinale), and

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lemongrass (C. citratus) on the growth and efficiency of food consumption of pest insects, as for this research is 5th Instar Maggot of H. armigera.

The usage of botanical insecticides in overcoming the pests of H. armigera issues has been widely carried out. This is due to its very destructive nature in many horticultural plants and its high resistance to insecticides, so the concentration of botanical insecticides that can cause death in the pest insects will be more effective and efficient in controlling other horticultural pests.

2 METHODOLOGY

2.1 Maintenance of Experimental Animals

The larvae from the cornfield are nurtured in a laboratory with its natural food. The mature larvae are inserted into the breeding cage. Inside the cage was placed a solution of honey and sugar as food, and on the top and three sides of the cage were placed clothes as a place for laying the eggs. After the eggs hatched, the larvae are kept in artificial food in plastic cups to have relatively the same size until it reached the fifth instar larvae as the test animals (Waldbauer et all, 1984).

2.2 Provision of the Artificial Food

800 ml of distilled water were boiled to dissolve other ingredients. Mix 50 grams of corn meal, 50 grams of soybean juice and 30 grams of wheat germ, then blend with distilled water. Then, mix 20 grams of rice flour, 50 grams of cornstarch, 50 g of sugar and 100 ccs of distilled water. After becoming a paste, add 12 grams of vitamin, 6 grams of ascorbic acid, , 2.5 grams of nipagine, and 2 grams of sorbic acidthen beat well. Next enter ten ccs of corn oil. After the temperature is 70 ° C, all the ingredients were mixed. Add 15 grams of yeast and 10 ml of formalin. Furthermore, the food was placed on the plastic cups where the larvae were maintained.

2.3 Procurement of the Ethanol Extract of Sweet Orange Peel (C. sinensis), Mexican Sunflower (T. diversifolia), Ginger Rhizome (Z. officinale), and Lemongrass (C. citratus)

Sweet orange peel (C. sinensis), Mexican sunflower (T. diversifolia), ginger rhizome (Z. officinale), and lemongrass (C. citratus) were macerated with ethanol for 3x24 hours. The process was repeated until the color of the obtained solution is translucent (assumed ethanol attracted all polar and non-polar compounds). The obtained macerate produced a concentrated ethanol extract of sweet orange peel (C. sinensis), Mexican sunflower (T. diversifolia), ginger rhizome (Z. officinale), and lemongrass (C. citratus) since it was condensed at 40 ° C with a rotary evaporator (Isman, 2008).

2.4 Experimental Test of the Ethanol Extract of Sweet Orange Peel (C. sinensis), Mexican Sunflower (T. diversifolia), Ginger Rhizome (Z. officinale), and Lemongrass (C. citratus) on the Development and Efficiency of the Nourishment Intake of the Fifth Instar Larvae of H. armigera

The artificial food was prepared with 6 treatment concentration types of (0%, 0.25%, 0.50%, 1.00%, 2.00%, 4.00%) with Nutrition Index testing parameters (Waldbauer, 1968):

- Relative Growth Rate (RGR)

$$\frac{G}{T \times A} \quad (1)$$

- Relative Consumption Rate (RCR)

$$\frac{F}{T\ x\ A} \quad (2)$$

- The efficiency of Conversion of Digested Food (ECD)

$$\frac{G}{F - E \times 100\%} \quad (3)$$

- The efficiency of Conversion of Ingested Food (ECI)

$$\frac{G}{F \times 100\%} \quad (4)$$

- Approximate Digestibility (AD)

$$\frac{F \quad E}{F \times 100\%} \quad (5)$$

Note: G = Larvae weight gain during meal period (initial weight of larvae - final weight of larvae)
F = Amount of the food depleted
E = Dry weight of feces
T = Eating period
A = The average weight of grub during the feeding period (initial weight of larvae + finale weight of larvae 2)

2.5 Experimental Design

This study applied the Complete Randomized Design (CRD) with six mixture concentration of treatments (0%, 0,25%, 0,50%, 1,00%, 2,00%, 4,00%) with a 1:1 ratio of the ethanol extract from sweet orange peel (C. sinensis), Mexican sunflower (T. diversifolia), ginger rhizome (Z. officinale), and lemongrass (C. citratus) and a recurrence of fifteen larvae.

3 DATA ANALYSIS

Variance analyzed each observation parameter data, if there were significant differences, it followed by the Duncan test at a 5% of confidence level.

4 RESULT AND DISCUSSION

In accordance with the test on The Influence of Ethanol Extracts of Numerous Plant Types on The Development and Efficiency of Nourishment Intake of fifth Instar Larvae of Heliothis Armigera Hubner, the obtained results are as follows:

4.1 The Impact of the Ethanol Extract of Sweet Orange Peel (C. sinensis), Mexican Sunflower (T. diversifolia), Ginger Rhizome (Z. officinale), and Lemongrass (C. citratus) on Relative Growth Rate (RGR) and Relative Consumption Rate (RCR) of the Fifth Instar Larvae of H. armigera

Based on the performed test, as in Table 1, it shows that all treatment concentration of the ethanol extracts of sweet orange peel (C. sinensis), Mexican sunflower (T. diversifolia), ginger rhizome (Z. officinale), and lemongrass (C. citratus) can lead to the depression of Relative Growth Rate (RGR) and Relative Consumption Rate (RCR).

Table 1: Relative Growth Rate (RGR) and Relative Consumption Rate (RCR) of the fifth instar larvae of H. Armigera on the food with the sweet orange peel's ethanol extracts (C. sinensis), Mexican sunflower (T. diversifolia), ginger rhizome (Z. officinale), and lemongrass (C. citratus).

Treatment (%)	RCR (mg/mg/h)	RGR(mg/mg/h)
0,00	1,50a ± 0,04	0,27a ± 0,01
0,25	1,57b ± 0,07	0,27a ± 0,01
0,50	1,52a ± 0,08	0,25ab ± 0,01
1,00	1,43b ± 0,04	0,23bc ± 0,02
2,00	1,20d ± 0,09	0,19cd ± 0,01
4,00	1,07e ± 0,11	0,15d ± 0,02

Notes: N=15 for every treatment. The mean value of ± SE (error) followed by the same lowercase letter in one column is not significantly different (Duncan test will be performed after ANOVA at 5% level)

Table 1 shows that in the treatment of 0.25%, there was a 4.46% increase in RCR with a value of 1.57 mg/mg / h which is statistically different compared to the control RCR value of 1.50 mg/mg / h. This implies that the treatment concentrations have not affected the larvae feeding activity. The decreased value of RCR, RGR began to occur at the concentration of 1.00% - 4.00%, and it decreases as the treatment concentration increased. This decrease can be caused by the ethanol extracts of sweet orange peel (C. sinensis), Mexican sunflower (T. diversifolia), ginger rhizome (Z. officinale), and lemongrass (C. citratus) which contain secondary metabolites that are toxic to the larvae. In previous research, it stated that the plants of Azadirachata indica, Curcuma longa, Acorus calamus (Rajput et all, 2003), Azadirachata indica, Quassina amara (Aggarwal et all, 2006), Cuorophia guianensis (Dadang and Djokol, 2011), Mahogany, Neem, Tobacco (Rahman et all, 2014), Nigella sativa plant, Aristolochia, and Jatropha curcas (Baskar et all, 2010) are toxic to H. armigera. The combination of sweet orange peel with neem leaves is toxic to Spodoptera litura (Tarigan et all, 2012). It is shown that the secondary metabolites contained in these four types of plants can be toxic to insects. The plants can produce various types of secondary metabolites such as flavonoids, terpenoids, alkaloids, and more, which are used as self-defense, and are toxic to insects. Therefore plants can be used as botanical insecticides (Rattan, 2010).

Table 1 also indicates that the decrement in RCR will cause a decrease in larvae RGR. This decrease is greater as treatment concentration increases. The details can be seen in Figure 1.

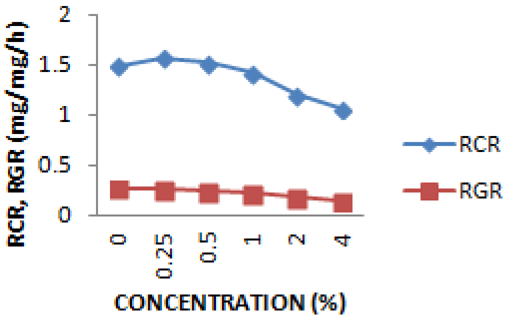

Figure 1: Relative Growth Rate (RGR) and Relative Consumption Rate (RCR) of the fifth instar larvae of *H. Armigera* on the food with the ethanol extracts of Mexican sunflower (*T. diversifolia*), sweet orange peel (*C. sinensis*), ginger rhizome (*Z. officinale*), and lemongrass (*C. citratus*).

4.2 The Influence of the Ethanol Extract of Sweet Orange Peel (C. sinensis), Mexican Sunflower (T. diversifolia), Ginger Rhizome (Z. officinale), and Lemongrass (C. citratus) on Approximate Digestibility (AD), Efficiency of Conversion of Ingested diet (ECI), and Efficiency of Conversion of Digested Food (ECD) of the Fifth Instar Larvae of H. armigera

Based on the conducted test as shown in Table 2, it shows that all treatment concentrations of the ethanol extracts of sweet orange peel (C. sinensis), Mexican sunflower (T. diversifolia), ginger rhizome (Z. officinale), and lemongrass (C. citratus) that were put into the larvae diet seem to affect the efficiency of food use, namely; in the form of a decrease in the efficiency of the conversion of digested nutrient (ECD), as well as in the efficiency of conversion of ingested food (ECI), also an increase in the approximate digestibility (AD).

Table 2: Approximate digestibility (AD), the efficiency of the conversion of digested nutrient (ECD), and the efficiency of conversion of ingested diet (ECI) of the fifth instar larvae.of H. armigera pada on the food added with the ethanol extracts of sweet orange peels (C. sinensis), mexican sunflower (T. diversifolia), ginger rhizome (Z. officinale), and lemongrass (C. citratus).

Treatment(%)	AD (%)	ECD (%)
0,00	30,34a ± 1,53	62,63a ± 3,38
0,25	28,78a ± 0,98	60,37ab ± 3,10
0,50	31,01a ± 1,39	53,51bc ± 1,89
1,00	35,92b ± 2,05	47,21cd ± 3,45
2,00	37,41b ± 1,44	43,63de ± 3,16
4,00	39,71b ± 2,13	36,92e ± 2,23

Notes: N=15 for every treatment. The mean value of ± se (error) followed by the same lowercase letter in one column is not significantly different (Duncan test will be performed after ANOVA at 5% level)

The digression of ECD and ECI occured in treatment concentrations of 0,50% - 4,00% with a decrease range of 14,56% - 41,05% and 11,67% - 19,78%) for ECD and ECI respectively. On the contrary, the value of AD arisen at the treatment concentrations of 1,00% - 4,00% with an increase of 18,39%-30,88%. The details of the test is shown in Figure 2.

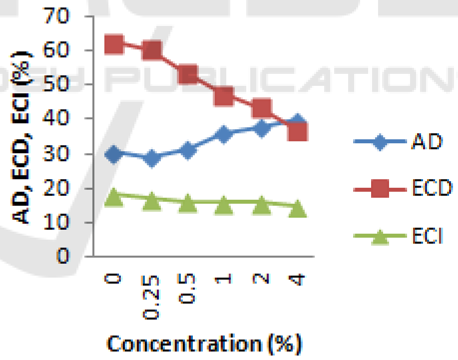

Figure 2: Approximate digestibility (AD), the efficiency of conversion of ingested nourishment (ECI), and the efficiency of the conversion of digested nourishment (ECD) of the fifth instar larvae.of H. armigera pada on the food added with the ethanol extracts of Mexican sunflower (T. diversifolia), ginger rhizome (Z. officinale), sweet orange peel (C. sinensis), and lemongrass (C. citratus).

The decrement of ECD and ECI, as well as the increasing value of AD in treatment concentration of 0,50% - 4.0%, becomes higher as the treatment concentration increases, and it differs from the control value statistically. Thus it can be stated that these treatment concentrations are effective to affect the efficiency of larvae food utilization. As an indication, it can be seen from RGR value which is also decreasing. Whereas the decrease in larvae RGR will be greater as the ECD and ECI decrease. While an increase in the value of AD is a compensation response so larvae can survive. According to the previous study, if there are toxic compounds in the food, insects will perform compensatory responses, including an increase in AD values (Simpson and Simpson, 1990). Chaniago et all (2013) explained the AD value of silkworm will increase if there is a lack of nutrition in the food. Furthermore, mangrove bark (Rhizophora mucronata) is reported to be toxic and inhibits the growth and feeding activity of H. armigera larvae (Rajput et all, 2003). The combination of Annona scuamosa seeds, Piper retrofractum fruit, Tephrosia vogelii leaves is lethal and suppress the appetite of the vegetable pests of Crosidolomia pavonang (Grainge and Ahmed, 1988).

5 CONCLUSIONS

Based on the studies, it can be concluded that the ethanol extracts of sweet orange peel (), Mexican sunflower (T. diversifolia), ginger rhizome (Z. officinale), and lemongrass (C. citratus) have effects on the development and efficiency of diet intake of the fifth instar larvae, such as the decline in Efficiency of conversion of ingested nourishment (ECI), Efficiency of conversion of digestive diet (ECD), and relative consumption rate (RCR), as well as value increment of the approximate digestibility (AD) with the effective concentration of treatment at 2.0%.

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