

EVALUATION OF ALTERNATIVES FOR WHEAT GERM OIL AS AN ENHANCER FOR MELON FRUIT FLY LIQUID LARVAL REARING DIET

Background. Wheat germ oil is one of the most significant ingredients used in preparing the liquid larval diet, which is used for rearing fruit flies and determining the larval production. Wheat germ oil is used by numerous research facilities and costs approximately >\$100 per gallon.

Objective. The objective of this research study was to find an inexpensive oil that could be used as an effective alternative for wheat germ oil and that would provide enough fatty acids for the larvae to develop normally. We hypothesized that the oil that contains the highest percentage of fatty acids and Vitamin E would be an effective alternative for the use of wheat germ oil.

Methods. The fruit flies known as the melon fruit flies, *Bactrocera Cucurbitae*, were selected for this research. Four different, inexpensive, commonly used oils, all containing approximately the same percent of total fat, were used for comparison and testing: corn oil, vegetable oil, canola oil, with 10% vitamin E, and canola oil with 20% vitamin E. For the research, we used five trays of fruit flies, each with a different oil and the control oil, wheat germ oil. We analyzed: larval duration, pupal recovery, pupal weight, adult emergence, adult fliers and percent mating.

Results. No significant differences were found in any category between wheat germ oil and the commonly used, inexpensive oils.

Conclusions. All the oils tested in this study had good potential to serve as substitutes for wheat germ oil in the fruit fly larval rearing diet. We recommend corn oil as the first choice for an alternative to wheat germ oil.

Student Researcher: Fasia Afuola National Institute of Health/
NIDDK Step Up Program

Mentors: Chiou Ling Chang, USDA-ARS-HNL, Hawaii
Qing Xiao Li, University of Hawaii-Manoa

BACKGROUND

Fruit flies are the most destructive vegetable and fruit pests worldwide. Fruit flies cause a great deal of contamination in various types of fruits and vegetables and also may lead to crop contamination. The sterile insect technique (SIT) is one of the most effective fruit fly control methods. Through this technique, large quantities of target insects are reared in a “factory” and males are sterilized by exposing them to low doses of radiation. These sterile male flies are then released by air over infested areas, where they mate with wild females. If the sterile males vastly outnumber the fertile wild males, the wild fly population quickly dies out.

METHODS

The liquid larval diet was developed to support SIT. In evaluating how each alternative works on the melon fruit fly, we used eight different parameters: larval development, pupal recovery, pupal weight, adult emergence, adult fliers, mating, egg production, and egg hatch.

My first step was to purchase four different cheap, commonly used oils, which all contained about the same percent of total fat. These oils included: corn oil with a 21% total fat, vegetable oil with a 21% total fat, canola oil with a 21% total fat and 10% Vitamin E, and canola oil with a 22% total fat and 20% Vitamin E. For the experiment control, I prepared a liquid larval diet that contained no wheat germ oil. I first prepared a liquid larval diet for each of the six trays (bento size) with the name

of each of the oil taped on each tray (+WGO, -WGO, corn oil, vegetable oil, canola oil 10% E and canola oil 20% E).

Next, I measured the ingredients used to prepare the liquid larval rearing diet and mixed all the ingredients with water except for the citric acid. The citric acid was used to adjust the level of the pH to 3.5. The melon fly eggs were then placed on a small piece of sponge with the liquid larval rearing diet beneath it. I chose to do three replications of each treatment, so I prepared a total of eighteen bento trays since there were six different treatments. The eggs were then left in a different room where they were able to mature into larvae.

Once the eggs became larvae, I prepared for the larval collection. The larvae were collected in circled containers to which vermiculite was added. The vermiculite helps the larvae pupate normally. After 1–2 days, I sifted each treatment that was collected and began to count the 4 lots of 100 pupae and weighed them to determine the percentage of pupal weight and pupal recovery. After I completed weighing the 4 lots of 100 pupae for each treatment, I then set up flight tests to determine the melon fruit fly’s flight ability. The 4 lots of 100 pupae were individually placed into petri dishes with the name of each treatment labeled on the bottom. They were then left in the cages until they had emerged and died. After, I collected the flight tests of each treatment and they were scored into three different categories: partially emerged, damaged wing, non-fliers (flies had emerged, but were not able to fly), and unemerged.

Once the flight test parameter was completed, I then prepared for the mating and egg testing. Twenty grams of pupae were placed into adult emergence cages with food and water. Once the pupae had emerged, I separated the males and females into different cages for each treatment until 10–11 days when they will become sexually matured. After 10–11 days, I released the males into the female cages to see which ones would pair up and mate. The mating pairs were collected and counted, then killed while the others were counted then killed.

After the mating test was completed, the egg testing was then performed. I set-up different egg testing cages, and I prepared the egg testing cups, which contained a small container with holes and a small piece of sponge with tomato juice. I poked holes into the small butter cups so that the females could lay their eggs into the cups. The butter cups were collected for 6–7 days and the largest amount of eggs produced were used to complete the egg testing process. The eggs were collected and weighed and the data were analyzed for the total amount of eggs produced daily from each treatment.

Lastly, the egg testing was performed. I used small green paper that would fit into the petri dishes and separated them into four different rows. Then I obtained the eggs using a pipette and put a small drop onto the four different rows. I then spread the eggs down the line carefully making a thin line of eggs, to allow counting 100 eggs per line under a microscope. After I counted the 100 eggs per row for each treatment, I waited until 6–7 days until I counted the amount of eggs that did NOT hatch. The data for the egg testing were then recorded and analyzed to determine the percentage of egg testing for each treatment.

RESULTS

Each parameter used to evaluate effectiveness worked on the melon fruit fly. For most of the testing situations, the samples with no wheat germ oil had the most variances from the other five samples. The tray without wheat germ oil exhibited: 1) slight delay in larval development; 2) significant reduction in percentage of pupal recovery;

3) significant increase in pupal weight; 4) lower mating; poorer egg production; 5) significantly lower egg testing. For the mating test, the flies reared in the diet with WGO, corn oil, and canola oil (20%E) have significantly better mating than those with vegetable oil and canola oil (10%E). The flies reared as larvae in the diet with WGO, corn oil, and canola oil (10%E) have significantly better egg production than those in the diets with vegetable oil, canola oil (20%E) or no oil.

CONCLUSION

All oils tested in this study have great potential to be substitutes for wheat germ oil in the fruit fly larval rearing diet in that the flies performed as well as those on the wheat germ oil diet.

We recommend corn oil as our first choice for an alternative.

REFERENCE

1. Chang CL, Vargas T, Caceres C, Jang E, Cho ILK. *Entomology Society of America*. 2006;99(6):6.