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The Effects of Vitamin E on the Longevity of *Drosophila melanogaster*

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ABSTRACT

Many advantages of taking Vitamin E, tocopherol, have long been known. One of the recent questions is: Will Vitamin E increase longevity? *Drosophila melanogaster*, the fruit fly, is the subject of this study due to it's relatively short life span. Most fruit flies die before the age of 60 days. The results showed that Vitamin E does affect lifespan, however, it does not affect longevity of *Drosophila melanogaster* by increasing their life span. In fact, Vitamin E was shown to do the opposite. In small doses (1%), Vitamin E did not statistically alter longevity, but in slightly larger doses (2.5% and 4.5%) Vitamin E was shown to statistically decrease longevity. Fifty-percent survivorship curves also shows a statistical decrease in longevity in those same groups.

INTRODUCTION

Vitamin E, tocopherol, is a lipid vitamin. Lipid vitamins are polyprenyl compounds composed primarily of long hydrocarbon chains or fused rings. Vitamin E, which contains non-polar groups, is more soluble in a lipid environment than in an aqueous one (Horton et al., 1993). One of the important biological activities known is antioxidant activity. Antioxidants offer a high degree of protection to intercellular macromolecular structures (Baker, 1993). In mammals, vitamin E may help slow atherosclerosis (Gutfeld et al., 1992), lower the risk of angina (Anonymous, 1991), and increase immunity (Schmidt, 1993). If these same properties apply to fruit flies then perhaps vitamin E will increase their life span.

The role of free radicals and the effects of antioxidants in the processes of aging has been the subject of numerous research effort (Baker, 1993). A free radical is any species capable of independent existence that contains one or more unpaired electrons (Halliwell, 1993). The sensitivity of an organism to oxidative damage depends on the balance between the levels of antioxidant defense and free radical challenge. A major source of free radicals may be the electron transport chain in mitochondria (Warner, 1993). There is not a clear understanding of the intra- and inter-relationships between endogenous free radical production and the mechanisms regulating antioxidant defense systems, there is encouraging evidence that antioxidant intervention can enhance or retard the age related decline some physiological systems experience as well as increase life span (Baker, 1993).

A study performed with vitamin E and it's effects on atherosclerosis showed that men taking vitamin E supplements saw their LDL (low-density lipoprotein) cholesterol to be 50% less likely to undergo oxidation. When the cholesterol particles undergo oxidation they are affected detrimentally. This in turn could cause clogged arteries and lead to a heart attack (Gutfeld et al., 1992).

Also, vitamin E is useful in mammals because it may help lower the risk of angina. Angina is a form of chest pain that often precedes heart attacks (Anonymous, 1991). Since vitamin E helps slow atherosclerosis (Gutfeld et al., 1992) and helps lower the risk on angina (Anonymous, 1991) the risk of heart attack is lowered. Also, there was a study performed on vitamin E and longevity in rats. That study concluded that vitamin E did increase life span in rats, however, the study was not able to be located.

Vitamin E has also been associated with elevated immunity. People who took vitamin supplements with extra doses of vitamin E and beta carotene spent half as many days sick with infections as those in the study taking placebos. The study concluded that the people taking the supplements had stronger immune systems (Schmidt, 1993).

When these facts and studies are put together it is easy to assume vitamin E can increase health. In fact, it does, but will it increase life span? In the United States only 1/4 of the total population consumes the RDA (Recommended Dietary Allowance) of vitamin E. Actually 50% consume less than ½ of the recommended amount (Block, 1993). Americans definitely need to take more vitamin E to improve their health, even if it does not increase life span.

Drosophila melanogaster (fruit flies) were the subjects of this study because of their short life cycle. Also, their small size and easy care make them good subjects. Since they are small many flies can live in one vial without being overcrowded. A study was done on the longevity of fruit flies and most fruit flies die between the age of 40 and 60 days. (Baranaga, 1992).

MATERIALS AND METHODS

The flies used in this experiment were of the wild-type origin. The toxicity of vitamin E on *Drosophila melanogaster* (wild-type) was determined to be 5% on a weight:weight basis for both larvae and adults (Baker, 1993).

Four groups of 100 flies each were fed accordingly:

Group One---normal diet (control group)
Group Two--normal diet with 1% vitamin E
Group Three-normal diet with 2.5% vitamin E
Group Four--normal diet with 4.5% vitamin E

These percentages were chosen due to the toxicity level being 5%. The percentages of vitamin E were

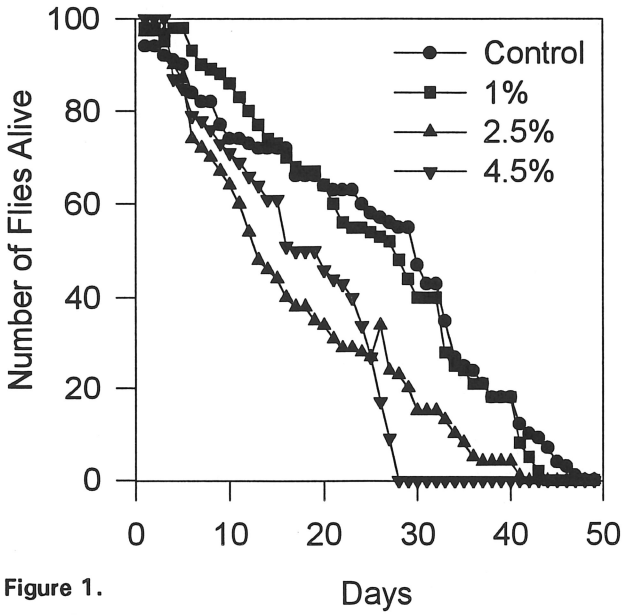


Figure 1.

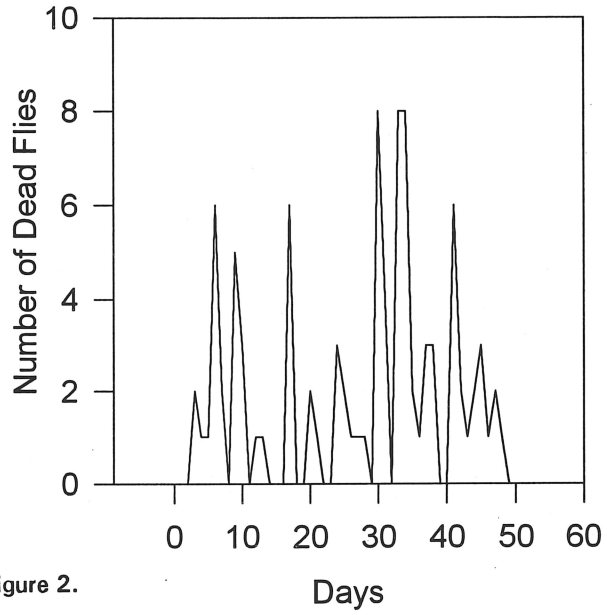


Figure 2.

based on food weight and not on body weight. The normal diet consisted of *Drosophila* medium. The vitamin E was mixed into the medium during the preparation process. When the flies ate they consumed the vitamin. The medium solidifies so that the vitamin was trapped.

The cultures were kept out of direct sunlight in vials containing 10 flies each. The temperature was kept between 20 and 25 degrees Celsius. A higher temperature may have decreased life span due to the flies optimum temperature (Flagg, 1981). The cultures were on a 12 hour/12 hour--light/dark cycle (Luckinbill et al., 1990). The eggs and live flies were transferred to new vials daily. This prevented new flies from altering results and dead flies from contaminating the food supply.

RESULTS

The data was collected and a Kruskal-Wallace one way anaylsis of variance was performed.

Fifty percent survivorship was determined to be:

31.5 days for the control group
28.2 days for the 1% vitamin E group
15.0 days for the 2.5% vitamin E group
18.3 days for the 4.5% vitamin E group

Twenty-five percent survivorship was determined to be:

35.0 days for the conrol group
34.0 days for the 1% vitamin E group
25.7 days for the 2.5% vitamin E group
25.4 days for the 4.5% vitamin E group

Ten percent survivorship was determined to be.

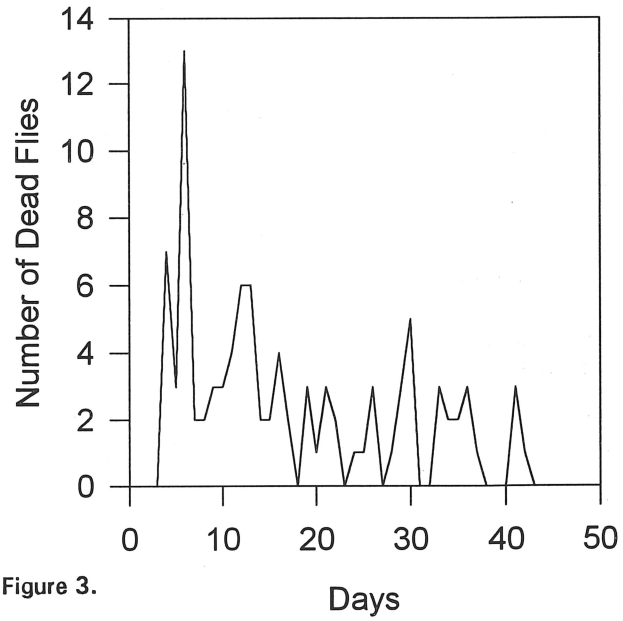
42.9 days for the control group
40.9 days for the 1% vitamin E group
34.0 days for the 2.5% vitamin E group
26.9 days for the 4.5% vitamin E group

Using the Student-Newman-Keuls Method there was shown to be a statistical difference between the control group and the 2.5% and 4.5% vitamin E groups. Also, it was shown that the control and 1% groups did not differ statistically.

All of the control group flies were dead on the 48th day. All of the 1% vitamin E group flies were dead on the 45th day. The 2.5% vitamin E flies were dead on the 42nd day and the 4.5% vitamin E flies were dead on the 28th day.

DISCUSSION

Vitamin E adversely affected the longevity of the flies at the higher vitamin E levels. The lowest dose of



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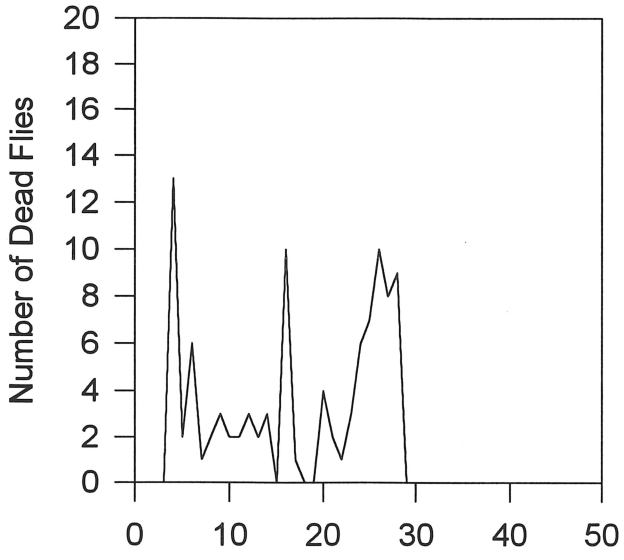

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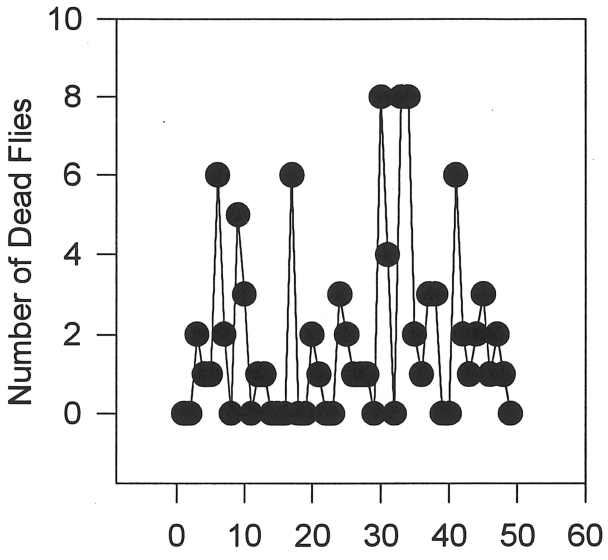

Figure 5.

vitamin E (1%) neither prolonged nor decreased longevity. On the other hand, the higher doses (2.5% amd 4.5%) decreased life span. These results can be seen on the mortality curve for all groups (Fig. 1). The range of deaths over time can be seen in Figs. 2-5.

The 4.5% vitamin E flies appeared to be less active and not as hungry compared to the control group. The 2.5% vitamin E flies appeared to be more active, hungrier, and laid more eggs than the control group. The 1% vitamin E flies did not differ in any of these aspects from the conrol group.

A recent study done on the effects of various antioxidants on *Drosophila melanogaster* showed that vitamin E did increase longevity in mutant Drosophila, but not in wild-type (Baker, 1993). Perhaps the missing links in the genetic structure of the mutants make them more responsive to these levels of vitamin E.

In this study it was shown that vitamin E did not increase longevity. Longevity was either kept the same (1% group) or decreased (2.5% and 4.5% groups). If this study had been done on mutant flies then perhaps positivie results would have been seen. This study still had positive aspects however, it was a great learning experience.

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