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Research Article

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Fruit body extract of *Pleurotus ostreatus* (oyster) mushroom enhances pre-adult fitness in *D. melanogaster.*

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Abstract

Nutrition comprises both qualitative and quantitative dimensions, interact with the fitness of an organism such as an organism's nutritional diet gives it the energy it needs for growth, development, reproduction, and survival. In the present study flies obtained from control media and *Pleurotus* (oyster) mushroom treated media were used to study rate of development and percentage of hatchability from larva to pupa and pupa to adult. It was noted that the flies reared in *Pleurotus ostreatus* (oyster) mushroom had taken lesser time for rate of development from larva to pupa and pupa to adult in *D. melanogaster*. The increasing concentration (2.5g, 5g, 10g) of oyaster mushroom decreases rate of development time (lesser time taken). Whereas the flies reared in control wheat cream agar media has taken greater time for rate of development from larva to pupa and pupa adult. The percentage of hatchability also shown positive result in the flies reared in *Pleurotus ostreatus* (oyster) mushroom. According to our study the flies reared in oyster mushroom had greater significance in percentage of hatchability from larva to pupa and pupa to adult than compared to control diet treated flies. Whereas the control wheat cream agar treated flies had shown significantly lesser percentage of hatchability. Thus oyster mushroom diet showed faster rate of development and increased % of hatchability showing its positive effects on pre-adult fitness in *D. melanogaster*.

Keywords: Nutrition, rate of development, % of hatchability, *D. melanogaster, P. ostreatus*.

Introduction

The nutritional impacts brought by the difference in food type availability and its nutrients are the most obvious way that environmental variation may affect growth, development and reproductive fitness. Diet effect can be categorized as quantitative (i.e., food availability) or qualitative (i.e., food composition) in general terms. Since animals rely on food for energy and other nutritional needs, the quantitative consequences are clear. As a result, under a wide range of natural circumstances, food supply and bodily health or fecundity are positively correlated.

Nutritional deficits and inhibitory metabolites are two groups into which qualitative impacts are frequently subdivided.

Animal survival and reproductive success depend on a healthy balance between energy intake and expenditure (Pough, 1989 and Sibly, 1991). This equilibrium depends on how food intake, digestion, and the distribution of newly obtained energy among various processes including maintenance, growth, and reproduction interact (Karasov, 1986). Food provides animals with energy and nutrition, hence diet can be regarded as a crucial factor that may have an impact on all aspects of their life histories (Sterner and Schulz, 1998; Taylor *et al.,* 2005). The investigation of how organisms alter their allocation of energy has been greatly aided by experimental changes to animal diets (Chown and Nicolson, 2004; Cruz-Neto and Bozinovic, 2004).

Under natural circumstances, it can be difficult for many species to achieve their supplemental dietary needs for somatic and reproductive growth (Raubenheimer and Simpson, 1999). Body tissues constantly require a particular amount and ratio of nutrients during development in order to achieve optimal growth and performance (Bauerfeind and Fischer, 2005). Characteristics like growth and reproduction can be affected by a lack or imbalance of fat, carbohydrates, or protein. In *D. melanogaster*, protein deficit lowers fertility and growth (Wang and Clark, 1995), and in fruit-feeders, protein is frequently a limiting macronutrient (Mattson, 1980; Adams and Gerst, 1991; Hendrichs *et al.,* 1991; Markow *et al.,* 1999; Markow *et al.,* 2001).

Both intrinsic and extrinsic factors known to affect all biochemical, physiological, and developmental changes that take place in an organism have an impact on the overall growth, development, and reproduction of an organism (Sterner and Schulz, 1998; Taylor *et al.,* 2005).

The diet contains various nutrients, such as proteins, carbs, vitamins, and minerals, it is good for the organisms. Numerous studies have been carried out using a range of diets, cool beverages, and organic fruits. For instance, Geetha and Krishna, 2015; Alwyn D'souza and Krishna, 2015; Krishna and Hallikar, 2008) studied Cocca and organically cultivated fruits, respectively. Natural resources made up of various fruits and vegetables have also demonstrated a positive impact on the pre adult fitness of the *D.melanogaster*, while studies on avocado and yogurt (Cleona Alexander and Krishna, 2018) have demonstrated a detrimental impact on that fitness.

The timing of the metamorphosis determines the development rate and length of the larva's growth stage, which can be changed to help the larva attain an adult size that will maximize fitness and survival in a variety of habitats. Animals that live in nutrient-rich environments grow swiftly and become adults very quickly. On the other hand, when nutrients are few, the larval growth stage is prolonged to permit more growth and to guarantee an acceptable final adult size despite difficult growth circumstances.

The model organism *D. melanogaster* has been extensively employed in the scientific sciences. *Drosophila* is a popular choice for life span studies because of its 60–80 day lifespan. Additionally, 60% of the fruit fly genes have mammalian orthologs. As a result, metabolic and signaling pathways are very conserved. *Drosophila* maintenance and reproduction are relatively inexpensive and don't call for expensive equipment. The fruit fly *D. melanogaster* is used as a model organism in research spanning from basic genetics through the development of tissues and organs and nutrition.

About 100 different bioactive substances may be found in the *P. ostreatus* fruiting body, which is primarily thought of as a potential new source of dietary fiber. Whereas, fungal cell wall are rich in

non-starch polysaccharides, of which β-glucan are most interesting functional components and phenolic compounds such as protocatechuic acid, gallic acid, homogentisic acid, rutin, myrictin, chrysin, naringin, tocopherol like α-tocopherol and γ- tocopherol, ascorbic acid and β-carotene of each having their own outstanding medical effects (Wang *et al*., 2001 and Ferreira *et al.*, 2009). Additionally, they are nutritious foods that are high in protein, lipids, carbs, vitamins, and minerals but low in calories and fat. However its effects on reproductive fitness has not been studied therefore present study has been under taken in *D. melanogaster* to study the effect of fruit body extract of *Pleurotus ostreatus* (Oyster) mushroom on rate of development and percentage of hatchability of *D. melanogaster*.

The *P. ostreatus* (oyster) mushroom is currently consumed in great quantities by mankind. Therefore, the current study has been undertaken to understand the effect of fruit body extract of *Pleurotus ostreatus* (oyster) mushroom on rate of development and percentage of hatchability in *D. melanogaster*. It aids in the treatment of conditions like cancer, diabetes, obesity, heart disease, hyperacidity, and hypertension, among others.

Materials and Methods

Collection of fruit body extract of Oyster (*P. ostreatus)* mushroom:

The fruit body extract of oyster mushroom powder was purchased from the ROOTED (Active naturals). Delivered by Amazon app by online.

Establishment of stock:

Experimental stock of the *D. melanogaster* K strain used in the study was provided by the *Drosophila* Stock Center. Department of Zoology, University of Mysore, Mysore; this stock was grown in bottles with wheat cream agar medium (added 100g jaggery, 100g wheat powder, 10g agar, 1000ml distilled water, and 7.5ml propionic acid). In a lab setting with a humidity of 70%, 12-hour cycles of darkness and light, and a temperature of 22°C ± 1°C, flies were housed. These flies were used to obtain experimental flies.

Experimental media preparations:

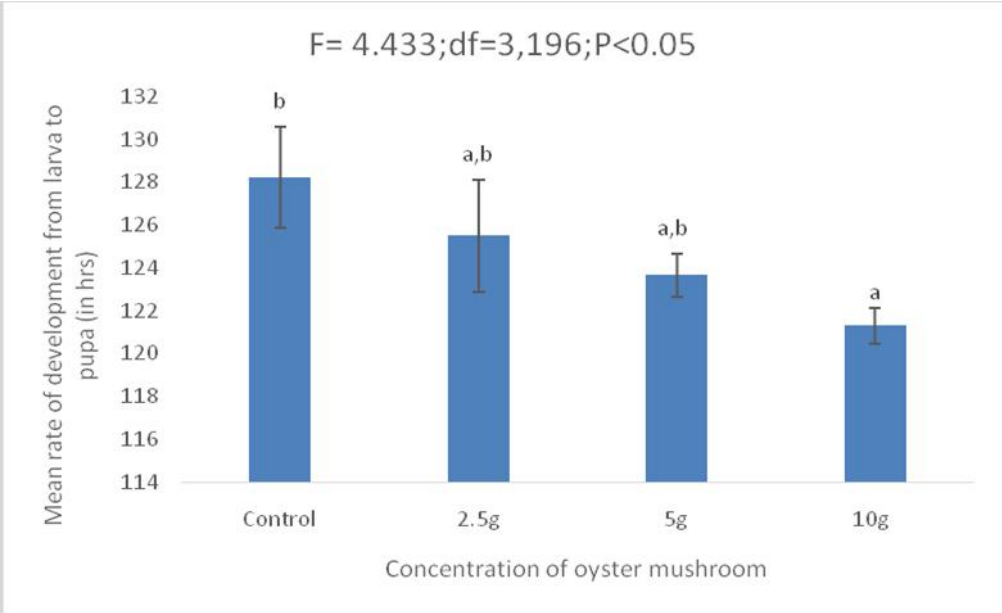
Wheat cream agar media was prepared by using 50g of jaggary, 50g of wheat powder, 5g of agar boiled in 500ml of distilled water and 3.8ml of propionic acid was added to avoid the growth of fungus. Experimental flies were obtained by adding 2.5g, 5g, 10g of Oyster mushroom powder respectively to the 100ml of wheat cream agar media. Whereas, flies cultured in wheat cream agar media were considered as control.

Effect of *Pleurotus ostreatus* (oyster) mushroom on Rate of development and percentage of hatchability in *D. melanogaster*

Ten first instar larvae were seeded separately into the each vial containing the wheat cream agar and different concentration of *P. ostreatus* mushroom diet. A total five replicates were made and larvae were observed for its development rate from larva to pupa, and from pupa to adult in hours. Further percentage of larvae to pupa hatching, pupual to adult eclosion were also noted. Separate experiments were performed for the wheat cream agar and different concentration of *P. ostreatus* (oyster) mushroom diet.

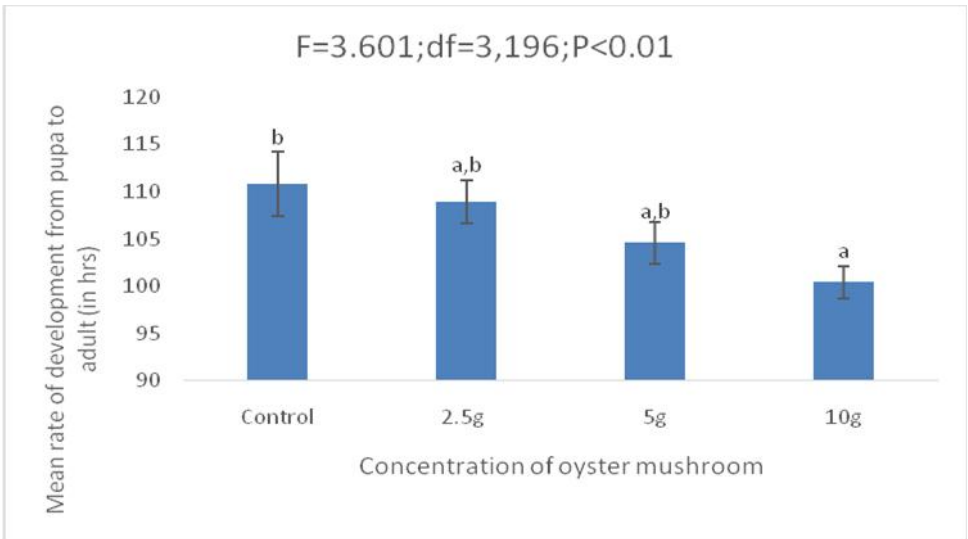
Results

FIGURE 1: The effect of different concentration of *P. ostreatus* (Oyster) mushroom diet on rate of development from larva to pupa of *D. melanogaster*. [Control diet- wheat cream agar media; Oyster mushroom diet (2.5g, 5g, 10g concentration).



The different letters on the bar graph indicate the significant variation between the different diets by Tukey's post hoc test at 0.05 level.

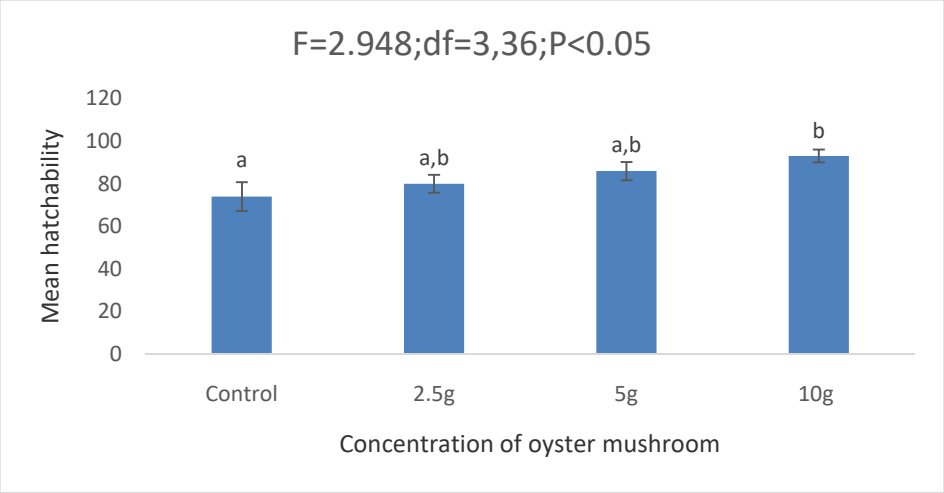
FIGURE 2: The effect of different concentration of *P. ostreatus* (Oyster) mushroom diet on rate of development from pupa to adult of *D. melanogaster*. [Control diet- wheat cream agar media; Oyster mushroom diet (2.5g, 5g, 10g concentration).



The different letters on the bar graph indicate the significant variation between the different diets by Tukey's post hoc test at 0.05 level.

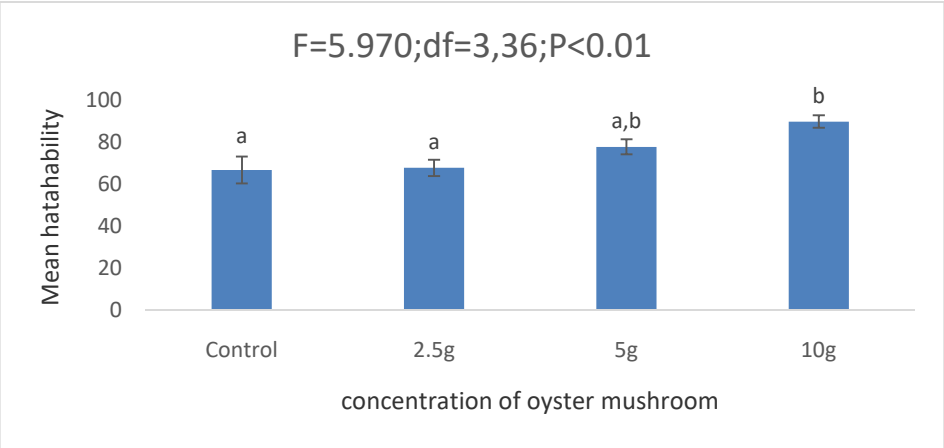
The rate of development data of larvae to pupa and pupa to adult reared in control wheat cream agar and *Pleurotus ostreatus* (oyster) mushroom treated flies. It was noted from the Figured (1 and 2) that larvae to pupa and pupa to adult rate of development was significantly faster (took lesser time) in oyster mushroom treated flies. Further, rate of development decreased with increasing concentration of oyster mushroom. The above data subjected to One way ANOVA followed by Tukey's post hoc test showed significance variation in rate of development from larvae to pupa and pupa to adult between control and oyster mushroom treated flies. Tukey's post hoc test showed that control flies have taken greater time for rate of development in both larvae to pupa and pupa to adult compare to 2.5g of Oyster mushroom treated mushroom flies. Further, non significance differences was observed in rate of development between different concentration of oyster mushroom treated flies.

FIGURE 3: The effect of different concentration of *P. ostreatus* (Oyster) mushroom diet on % of hatchability from larva to pupa of *D. melanogaster*. [Control diet- wheat cream agar media; Oyster mushroom diet (2.5g, 5g, 10g concentration).



The different letters on the bar graph indicate the significant variation between the different diets by Tukey's post hoc test at 0.05 level.

FIGURE 4: The effect of different concentration of *P. ostreatus* (Oyster) mushroom diet on % percentage of hatchability from larva to pupa of *D. melanogaster*. [Control diet- wheat cream agar media; Oyster mushroom diet (2.5g, 5g, 10g concentration).



The different letters on the bar graph indicate the significant variation between the different diets by Tukey's post hoc test at 0.05 level.

The percentage of hatchability data of larva to pupa and pupa to adult in control diet and oyster treated mushroom flies. It was noted from the figure (3 and 4) that larva to pupa and pupa to adult percentage of hatchability was significantly greater percentage of hatchability in oyster mushroom treated flies compared to control flies. Further, percentage of hatchability increased with increasing concentration of oyster mushroom. The above data subjected to One way ANOVA followed by Tukey's post hoc test showed significance variation in percentage of hatchability from larva to pupa and pupa to adult between control and oyster mushroom treated flies. Tukey's post hoc test showed that control flies had lesser percentage of hatchability in both larva to pupa and pupa to adult compared to oyster mushroom treated flies. Further non significance difference was observed in percentage of hatchability between different concentration of oyster treated mushroom.

Discussion

Rate of development and percentage of hatchability:

The data show that larvae that were fed a diet of *P. ostreatus* (oyster) mushrooms emerge more quickly (Figures 1 and 2). Fly emergence is accelerated (takes less time) as oyster mushroom concentration rises. The fact that larvae fed on oyster mushroom-treated media have almost twice the mass of those fed on wheat cream agar medium is interesting. Additionally, they don't need much more time to grow to this size. Therefore, larvae would convert the substrates into metabolized nutrient stores more quickly than when raised on different concentrations of oyster mushroom treated media. This is likely because oyster mushroom provides greater nutrient availability, which may be related to variations in media preparation. Previous studies have shown that nutrient-poor diets can cause smaller sized adults (Vijendravarma *et al.,* 2010). *Drosophila* reduced adult size and lower larval bulk could indicate inferior nutrition. It is also important to note that adult oyster mushroom-treated flies devour food much more quickly. They may directly attribute their enhanced health to this increased food consumption, or it may simply be a result of their noticeably larger size. When considered as a whole, our results show that the protein-rich oyster mushroom treated media include a nutrient balance that maximizes reproduction rates. Moreover, it greatly improves the fitness of young *D. melanogaster* individuals.

Various diets were also used in recent studies to analyze the fitness of pre-adult *D. melanogaster*. The impact of organic fruits and vegetables on the fitness of pre-adult individuals was demonstrated by Chabra *et al.,* 2013). It was discovered that flies that were given organic fruits experienced a noticeably higher level of pre-adult development speed. In a similar manner, Geetha and Krishna, 2015) conducted a study on *Drosophila melanogaster* and discovered that organic fruits such as chikku and watermelon have an impact on the development of pre-adult stages.. Further, Alwyn's DSowza and Krishna, 2015) also found the effect of alternative natural drink was beneficial in pre-adult development compared to the synthetic and natural juice. From all these studies it was noticed that the quantity and quality of nutrients present in the diet had an effect on pre-adult development in *D. melanogaster*. Our study also proves that the flies reared in different concentration of oyster mushroom impact on rate of development, rate of development decrease with increasing concentration.

Viability and hatchability are influenced by physical factors like temperature, moisture, light, and others as well as chemical variables like pH. Pre-adult viability, also known as hatchability, includes the stages of egg to larvae, larvae to pupae, and pupae to adult viability.(Figures 3 and 4) reveal that there was a substantial difference between the pre-adult development of flies given an oyster mushroom diet and those fed control media. The flies fed an oyster mushroom diet had high viability from larva to pupa and from pupa to adult and those compare to the flies reared in control wheat cream agar media. This shows that the oyster mushroom provide more of the nutrients and energy needed for the pre-adult growth of the larva to pupa and pupa to adult

stages than the control media, which do not supply the same amounts of nutrients and energy to raise the pre-adult fitness. With rising temperatures, the rate of *Drosophila* development tends to slow down. (Al-Saffar and colleagues, 1995; Gilbert and De Jong, 2001; Hartwell *et al*., 2011). The viability will come more quickly as the rate of development rises. This is so because the only thing different between control and oyster mushroom-treated flies' cultures, which were both grown in identical lab settings, was the nutrients in their food. Thus, we draw the conclusion that a diet including oyster mushrooms accelerates development and raises the percentage of hatchability in *D. melanogaster*.

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