

The Effect of Muesli on Developmental Rate in *Drosophila melanogaster*

Chandana Raj R¹, Chandana C V², Archana H T³, Bindu K⁴, Krishna M S*

*Department of studies in Zoology, University of Mysore, Manasagangotri, Mysuru - 560006, Karnataka, India.

Abstract

Drosophila melanogaster has been extensively used in developmental and nutritional research because of its short life cycle and well-characterized genetics. Nutritional composition of the culture medium plays an important role in regulating growth and developmental rate in this species. In the present study, flies were reared on wheat cream agar medium supplemented with different concentrations of muesli (10 g, 20 g, and 30 g) in order to evaluate the influence of dietary enrichment on larval and pupal development. The experiment was designed to determine the effect of muesli supplementation on the rate of development from larval to pupal stage and from pupal to adult stage in *D. melanogaster*.

Key words: Rate of development, larva, pupa, adult, *D. melanogaster*.

Introduction

The rate of development refers to the progression of growth and differentiation occurring from larval stages to adult emergence in an organism. In *Drosophila melanogaster*, developmental duration is widely used as an indicator of physiological fitness and nutritional status. Due to its short life cycle, ease of maintenance, and genetic similarity with higher organisms, *D. melanogaster* has become an important experimental model in nutritional and developmental biology (Staats et al., 2018). ([American Chemical Society Publications][2])

Nutrition is one of the most important environmental factors influencing growth and development in *D. melanogaster*. Earlier studies demonstrated that dietary protein and carbohydrate balance directly affect developmental time, body size, stress tolerance, and reproductive performance. Jang and Lee (2018) reported that variations in protein-to-carbohydrate ratios significantly altered developmental traits and metabolic fitness in *D. melanogaster*. Similarly, Rodrigues et al. (2015) observed that larvae select nutritionally balanced diets that minimize developmental time and improve growth efficiency.

Previous investigations have also shown that nutrient-rich larval diets can positively influence physiological performance in adult flies. Andersen et al. (2010) found that protein-enriched media improved developmental performance and stress resistance in *D. melanogaster*. Kristensen et al. (2011) further demonstrated that dietary protein content affects body mass, metabolism, and developmental success in fruit flies.

Muesli is a nutrient-dense dietary mixture composed of cereals, oats, nuts, dried fruits, proteins, vitamins, minerals, and carbohydrates. Because of its balanced nutritional profile, muesli may provide an efficient supplementary diet for supporting larval growth and metabolic activity in *D. melanogaster*. However, limited information is available regarding the influence of muesli supplementation on developmental rate in this organism. Therefore, the present study was undertaken to evaluate the effect of different concentrations of muesli supplementation (10 g, 20 g, and 30 g) incorporated into wheat cream agar medium on the developmental progression of *D. melanogaster* from larval to adult stages.

Establishment of stock Experimental

Oregon K strain of *D. melanogaster* used in the study was collected from Drosophila stock Centre, Department of studies in Zoology, University of Mysore, Mysuru and this stock was cultured in bottles containing wheat cream agar media [100g of jaggery, 100g of wheat cream rava, 10g of agar was boiled in 1000 ml distilled water and 7.5 ml of propionic acid was added]. Flies were maintained in laboratory conditions such as humidity of 70% and 12 hours darkness and 12 hours light cycles and temperature $22 \pm 1^\circ \text{C}$ for the flies that were obtained.

The flies obtained as above were used to establish the experimental stock with different diet media

[Wheat cream agar media: Wheat cream agar media was prepared from 100g of jaggery, 100g of wheat cream rava, 10g of agar boiled in 1000ml distilled water and 7.5 ml of propionic acid added to it].

30g of Muesli powder media: is prepared from 100g of jaggery, 80 g of wheat cream rava, 30g of Muesli powder, 10g of agar boiled in 1000ml of distilled water and 7.5 ml of propionic acid added to it.

20g of Muesli media: is prepared from 100g of jaggery, 90g of wheat cream rava and 20g of Muesli powder, 10g of agar boiled in 1000ml of distilled water and 7.5 ml of propionic acid added to it.

10g of Muesli powder: 10g of Muesli powder media: is prepared from 100g of jaggery, 70 g of wheat cream rava, 10g of Muesli powder, 10g of agar boiled in 1000ml of distilled water and 7.5 ml of propionic acid added to it.

The flies emerged from the wheat cream agar media and other experimental treated media under the same laboratory conditions as mentioned above were used to study the cold resistance experiment in *D. melanogaster*.

Materials and Methods

The Muesli was purchased from Loyal World supermarket, 1011, Udayaravi road, Kuvempu Nagara, Mysuru, Karnataka 570023, India. This Muesli was used to prepare the experimental media. They are ground into powder and kept for usage as a diet system.

Experimental procedure

To determine the influence of muesli on the rate of development approximately 20 flies, 10 male and 10 female flies grown in control media were collected. The gathered flies were placed into culture bottles of control, 10g muesli, 20g muesli, and 30g of muesli and left for 3 hours. Later, the flies were removed from culture bottles and it was left for 24 hours, to produce 1st instar larvae from the egg. For rate of development thirty 1st instar larvae were retrieved by scooping the media from the culture bottles. The collected 1st instar larvae were introduced in the vials containing their respective media – control, 10g, 20g and 30g muesli. Then these larvae were observed till they form pupa and the time noted exactly when they form pupa and it was further observed till the flies emerges from the pupa and time consumed for fly emergence from pupa is noted.

Results and Discussion

Effect on rate of development of *Drosophila melanogaster* from larva to pupa:

Figure 01: Diet plays a significant role in the growth and developmental progression of *Drosophila melanogaster* from larval to pupal stages. The present findings examined the influence of different concentrations of muesli supplementation (10 g, 20 g, and 30 g) on developmental rate in comparison with the control wheat cream medium. The observations demonstrated that larvae reared on the control wheat cream medium exhibited better developmental performance and higher survival rates than those cultured on the supplemented media. Among the experimental groups, the 10g and 30g muesli diet supported

moderate larval growth and pupation, indicating that a limited nutrient enrichment may aid development to some extent. The wheat cream agar media and 30 g muesli supplementation showed comparatively reduced developmental success, suggesting that excessive nutrient concentration may negatively influence larval metabolism and delay progression to the pupal stage. The superior performance of the 20g muesli media suggests that balanced nutritional composition is more effective for sustaining normal preadult development in *D. melanogaster*. Previous investigations by Markow and O’Grady reported that optimized dietary balance is essential for successful insect growth and developmental stability. Likewise, studies conducted by Sang and Lee highlighted that excessive dietary supplementation can disrupt metabolic regulation and reduce developmental efficiency in fruit flies. Furthermore, research by Bass emphasized that standard laboratory diets often provide more suitable carbohydrate–protein ratios for larval survival and pupation than highly concentrated artificial supplements. The present findings are consistent with these observations, as the 20g medium maintained higher larva-to-pupa viability compared with the wheat cream agar media 10g and 30 g muesli treatments.

Overall, the results indicate that while muesli supplementation may provide additional nutrients, increased concentrations do not necessarily enhance developmental outcomes. Instead, the 20g medium appeared to offer the most favorable conditions for efficient larval growth and successful pupal formation in *Drosophila melanogaster*.

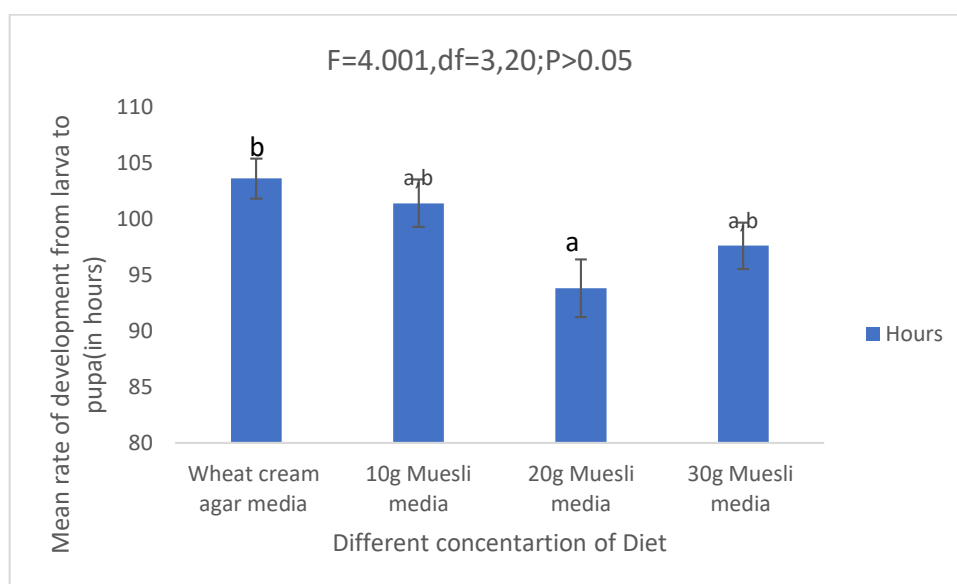


Figure 01: The effect of different concentration of muesli diet on the rate of development from larva to pupa of *D. melanogaster*.

Effect on rate of development of *Drosophila melanogaster* from pupa to adult:

Figure 2 illustrates the mean ± standard error of the developmental rate of *Drosophila melanogaster* from pupa to adult on wheat cream agar supplemented with different amounts of muesli. The findings showed that flies reared on wheat cream agar alone exhibited the highest rate of development. Among the supplemented diets, flies fed with 20g muesli developed faster than those fed with 30g and 10g muesli diets. The wheat cream agar media muesli diet showed the slowest developmental rate. Under identical laboratory conditions, variations in development were associated with differences in the nutrient composition of the diets. The study suggests that the wheat cream agar diet provided more suitable nutritional conditions for faster growth and development compared to the muesli-supplemented diets. Furthermore, although muesli supplementation influenced larval nutrition, excessive supplementation appeared to reduce the developmental rate from pupa to adult. Overall, the order of developmental performance observed was: 20g (highest), followed by 10 g muesli, 30 g muesli (lowest).

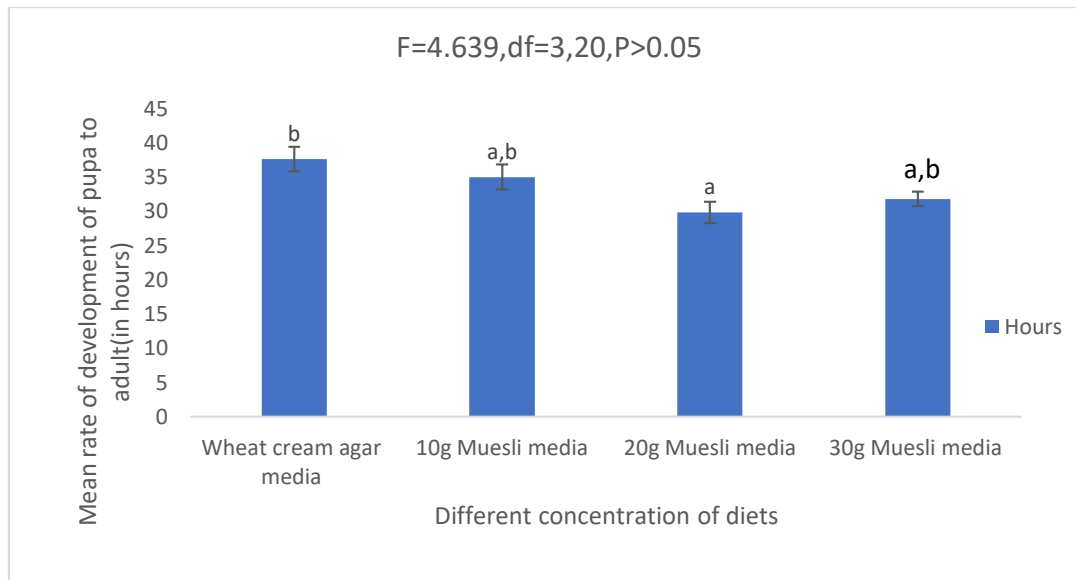


Figure 02: The effect of different concentration of muesli diet on the rate of development from pupa to adult of *D. melanogaster*.

Conclusion

In our studies we found that the flies fed with 20g and 30g had high greater rate of development compared to wheat cream agar and 10g media. Thus muesli increases rate of development in *D. melanogaster*.

Acknowledgement

The authors sincerely acknowledge the Chairperson Department of Studies in Zoology, University of Mysore, Manasagangotri, Mysuru, for her valuable support. We are also grateful to our guide Dr. M.S. Krishna Professor, Department of Studies in Zoology, University of Mysore, Manasagangotri, Mysuru, to his guidance, suggestions and support. And also grateful to the *Drosophila* Stock Centre, a National Facility at the University of Mysore, for providing essential facilities for carrying out the major project work. Additionally, we extend our heartfelt thanks to Miss. Chandana R for her assistance with the statistical analysis.

References

- Alexander, Cleona, and Krishna M.S. (2018). Effect of avocado and yogurt on pre-adult development of *Drosophila melanogaster*. *Annals of Entomology*. 36:1.
- AL-Saffar, Z. Y., Grainger, J. N. R., and Aldrich, J. (1995). Effects of constant and fluctuating temperature on development from egg to adult of *Drosophila melanogaster* (meigen). In *Biology and Environment: Proceedings of the Royal Irish Academy*. 95:119-112.
- Chhabra R, Kolli S, Bauer J.H. (2013). Organically grown food provides health benefits to *Drosophila melanogaster*. *PLoS One*. 9:8(1).
- D'Souza, A., and Krishna, M.S. (2015). Energy drinks' effect on pre adult development of *Drosophila melanogaster*. *Cancer Biology*., 5(2):1-6.
- Geetha, M. S., and Krishna, M.S. (2015). Effect of organic fruits (Chikku and Watermelon) on pre adult fitness in *Drosophila melanogaster*. *Cancer Biology*., 5(2): 29-34.
- Hoffmann A.A, Parsons P.A. (1991). *Evolutionary genetics and environmental stress*. Oxford University Press, Oxford.

7. Karasov W.H. (1986). Energetics, physiology and vertebrate ecology. *Trend Ecol Evol.*, 1: 101–104.
8. Vijendravarma, Roshan K., Sunitha Narasimha, and Tadeusz. Kawecki. (2010). “Effects of parental larval diet on egg size and offspring traits in *Drosophila*.” *Biology letters.*, 6(2):238-241.
9. Gilbert, P., and De Jong, G. (2001). Temperature dependence of development rate and adult size in *Drosophila* species: biophysical parameters. *Journal of Evolutionary Biology.*14:267-276.
10. Sterner, R.W, Schulz, K.L. (1998). Zooplankton nutrition: recent progress and a reality check. *Aquatic Ecol.* 32:261–279.
11. Pough, F.H. (1989). Organismal performance and Darwinian fitness: approaches and interpretations. *Physiol Zool.* 62:199–236.
12. Prathibha, M., Krishna M.S., and Jayaramu S.C., (2012). *Dros. Inf. Serv.* 95.
13. Robinson, S.J.W., and Partridge, L. (2001). *Journal of Evolutionary Biology* 14: 14-21.
14. Kiran, K. and Krishna, M.S. (2023). The effect of the Jeeni millet traditional mix on the starvation resistance in *Drosophila melanogaster*. 10(8): 115-126.
15. Krishna, M.S., and Uchenna U. Waturocha. (2013). The effect of pyrogallol on the resistance to starvation in *Drosophila bipectinata*. 9:127-136.
16. Shreeraksha, Shreejani, H.K., Krishna, M.S., (2023). Effect of Spirulina on Rate of development and Percentage of hatchability in *Drosophila melanogaster*. *Int. J. Adv. Res. Biol. Sci.* 10(8): 58-65.
17. Sibly R.M. (1991).The life-history approach to physiological ecology. **Func Ecol.**5:184.
18. Harshitha S., Krishna M.S., (2023). Fruit body extract of *Pleurotus ostreatus* (oyster) mushroom enhances pre-adult fitness in *D.melanogaster*. *Int.J. Adv. Res. Biol. Sci.* 10(8):135-142.

Copyright & License:



© Authors retain the copyright of this article. This work is published under the Creative Commons Attribution 4.0 International License (CC BY 4.0), permitting unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.