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The effect of rolled oats on pre adult fitness in *Drosophila Melanogaster*

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Abstract
Based on the type and amount of nutrients it contains, diet is one of the major extrinsic elements that affects an organism's ability to grow, reproduce, and survive. This study examines the impact of rolled oats on the rate of development and hatchability percentage in *Drosophila melanogaster* cultured on wheat cream agar, 25% oats, 50% oats, and 75% oats media. The rate of growth from larva to pupa was demonstrated to be faster with shorter periods of time in wheat cream agar media, but the rate of development slowed down as the concentration of oats increased (25%, 50%, 75% oats). This was contradiction to the rate of development from pupa to adult, where in wheat cream agar media, it was slower with longer duration of time, as the concentration of oats increased gradually developmental rate becomes faster with short duration of time. In contrast to rate of development, the percentage of hatchability in both larva to pupa and pupa to adult, reduced on increasing the concentrations of oats from 25%, 50%, and 75%. So, the rolled oats had slowed the rate of development from larva to pupa and speed up the eclosion of pupa to adult and reduced the percentage of hatchability from both larva to pupa and pupa to adult, this could be due to the high fibre content, protein diet, and presence of unique proteins respectively, this implies the varied effect of rolled oats on pre-adult fitness such as rate of development and hatachability percentage in *D. melanogaster*.

Keywords: Diet, rolled oats, *D. melanogaster*, rate of development, percentage of hatchability

Introduction

By impacting all biochemical, physiological, and developmental variations in an organism, intrinsic and extrinsic variables have an impact on its overall growth, development, and reproduction (Shreejani *et al*., 2023) [26]. Because it gives sustenance and energy and has an impact on an organism's life history, food is a crucial external factor (Sterner and Schulz, 1998 [28]; Taylor *et al*., 2005). [29] The amount and quality of food influence development, health, reproduction, lifespan, and stress tolerance (Lee *et al*., 2008 [19]; Hoffmann and Parsons, 1991 [15]: Rion and Kawecki, 2007) [25]. The relationship between food availability (quantity) and an organism's fitness is clear in a natural state since animals need food to survive. However, their energy and other demands come from their diet. Qualitative consequences of food, on the other hand, are frequently divided into two categories: nutritional inadequacy and inhibitory metabolites, which induce diseases. For many species, satisfying their additional nutritional demands in order to sustain their somatic and reproductive growth may be challenging in natural habitats (Raubenheimer and Simpson, 1999) [24]. In order to increase their chances of survival and reproduction in a changing environment, living things must alter their behavior, metabolism, and development. The organism must be able to identify and respond to fluctuations in its internal and external surroundings in order to survive in this environment. This necessitates careful tracking of light, temperature, oxygen, and food availability. This data is used by animals to adjust their metabolism and behavior at every stage of development in order to maximize resources and maintain homeostasis (Koyama *et al*., 2020) [18].

In order for body tissue to develop and operate correctly, it requires a constant mix and ratio of nutrients throughout its growth (Bauerfeind and Fischer, 2005) [4]. An imbalance or lack of protein, carbohydrates, or fat may affect characteristics like growth and reproduction (Wang and Clark, 1995) [31]. Changes in the diets of animals in experiments have greatly aided studies on variations in an organism's energy use (Chown and Nicolson, 2004; Cruz-Neto and Bozinovic, 2004) [7, 8].

As a result, a creature's diet is a crucial component of its growth. When it contains a variety of proteins, carbohydrates, vitamins, minerals, and other ingredients, it becomes more beneficial. Different research have used different diets, such those that examine the effects of organic fruits (Geetha and Krishna, 2015) [13], energy drinks (D'Souza and Krishna, 2015) [11], mass gainer (Aysha Barira H M and Krishna, 2024) [3], Spirulina (Sheejani *et al*., 2023), Jeeni millet traditional combination (Kiran and Krishna, 2023) [17], and other natural resources. Although studies on the Avocado and Yoghurt (Cleona Alexander and Krishna, 2018) [1], prebiotics (Shresta and Krishna, 2023) [27], whey protein (Manaswini D Kashyap and Krishna, 2024) [16], and creatine monohydrate (Mamba and Krishna, 2023) [20] had all demonstrated a negative impact on the pre-adult fitness of *D. melanogaster*, none had examined the effects of rolled oats on the pre-adult fitness of *D. melanogaster*. Consequently, the objective of the current study was to determine how rolled oats affected the pre-adult fitness of *D. melanogaster*.

Among all cereal crops, oat (Avena sativa L.) is unique because of its high nutritional value, which is useful in the manufacture of human food, animal feed, healthcare products, and cosmetics. One of the oldest crops known to man, it has been produced annually for over 2,000 years in different parts of the world. It didn't appear to be cultivated until thousands of years later, in comparison to other grains like wheat and barley. This cereal is a vital source of dietary soluble fiber, carbohydrates, well-balanced protein, lipids, vitamins, minerals, and a diverse array of phenolic chemicals. Between 13 and 20% of the protein in oat groats

comes from oats. The bulk of the proteins (around 30%) are found in the embryo. Oat beta-glucan (OBG) is a thick polysaccharide composed of a linear, branched chain of D-glucose monosaccharides joined by mixed β (1 → 3) and β (1 → 4) linkages. It is a major component of soluble fiber, with its main effects being to lower cholesterol and treat diabetes. Significant amounts of other bioactive compounds are also found in oats, including phenolic acids (such as avenanthramides (AVAs), p-hydroxybenzoic acid, vanillic acid, tricin, ferulic acid, caffeic acid, protocatechuic acid, syringic acid, p-coumaric acid, sinapic acid, tricin, apigenin, luteolin, kaempferol, and quercetin), tocols (Vitamin E activity is mainly contributed by tocopherols and tocotrienols, which together make tocols and sterols (Devendra Paudel *et al*., 2021) [21].

Materials and methods

To purchase rolled oats (gluten-free) in Mysore, we made use of the Swiggy instamart app. This oat product was used to create the test medium.

Establishment of stock

The Oregon K strain of *D. melanogaster* flies was obtained from the *Drosophila* stock center in the Department of Studies in Zoology at the University of Mysore, Manasagangotri, Mysuru. The captured flies were grown in bottles with wheat cream agar media (100g jaggery, 100g rava powder, 10g agar in 1000ml boiling distilled water, and 7.5ml propionic acid to prevent fungal growth). These flies were maintained in a laboratory setting with a 12:12 light-dark cycle, a temperature of 22+1°C, and a relative humidity of about 70%. Experimental stocks were grown using various dietary media and flies from the aforementioned stocks.

Establishment of experimental stock

Control medium (Wheat cream agar medium): This medium was made by combining 100 g of jaggery, 100 g of rava powder, and 10 g of agar in 1000 ml of boiling distilled water along with 7.5 ml of propionic acid.

25% Medium: For the 25% oats media, 10 g of agar, 100 g of jaggery, 75 g of suji, and 25 g of ground rolled oats were combined to 1000 ml of boiling distilled water along with 7.5 ml of propionic acid.

50% oats medium: is made by combining 50 g of grounded rolled oats, 50 g of suji, 100 g of jaggery, 10 g of agar, and 7.5 ml of propionic acid in 1000 ml of boiling distilled water.

In 1000 ml of boiling distilled water, 75 g of ground rolled oats, 25 g of suji, 100 g of jaggery, 10 g of agar, and 7.5 ml of propionic acid were combined to create the medium: 75% oats medium.

The current study employed flies collected from the aforementioned media.

Rate of development

To investigate the impact of rolled oats on the rate of development, 20 flies—both virgin females and unmated males—were collected from each of the following medias: wheat cream agar media, 25% oats media, 50% oats media, and 75% oats media. Each media was placed in bottles (plugged with cotton). The flies were gone in 24 hours. The media was extracted from the media bottles as 30 first-stage larvae were moved into several media bottles, each containing a different medium. The speed of metamorphosis from larva to pupa and from pupa to adult was determined in hours. All 30 of the flies that were seen in each of the wheat cream agar media, 25% oats media, 50% oats media, and 75% oats media were maintained in the lab environment described earlier.

Percentage of hatchability

To research hatchability, 30 first instar larvae were obtained by scooping media out of media bottles and moving them to other media bottles that each had a specific media. The proportion of larvae that hatched into pupae and the number of pupae that hatched into adults were counted for each of the wheat cream agar media, 25% oats media, 50% oats media, and 75% oats media.

Results

Effect of rolled oats on rate of development from larva to pupa in *D. melanogaster*

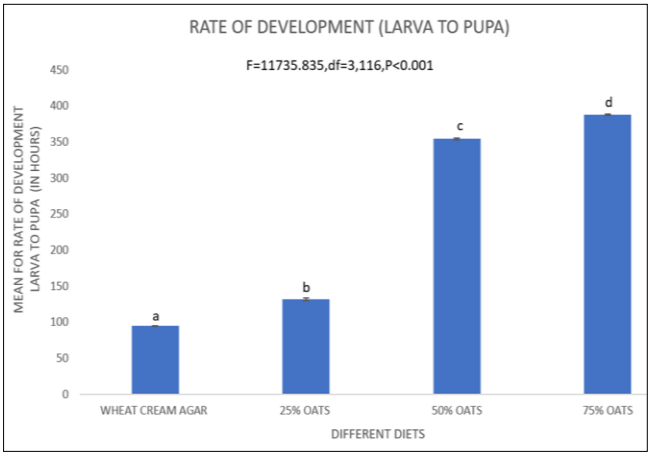

Fig 1: Effect of wheat cream agar medium and different concentration of oats media on rate of development from larva to pupa in *D. melanogaster*. (The different letter on the bar graph indicates the significant variation in the different diet by the Tukey's post hoc test at 0.05 level).

Figure-1 showed the mean and standard error value of larva to pupa rate of development in *D. melanogaster* larvae which were cultured in the wheat cream agar media, 25% oats media, 50% oats media and 75% oats media. This data showed that, larvae cultured in wheat cream agar media showed faster rate of development with shorter duration when compared to the different concentration of oats media from 25%, 50%, and 75% oats media. On increasing concentration of oats, the rate of development slowed down by longer duration of time.

This data is subjected to One-way ANOVA, followed by the Tukey's post hoc test which showed the significant variation in the rate of development from larva to pupa between the different diets. According to Tukey's post hoc test showed that Wheat cream agar media, 25%, 50%, 75% oats media showed significant variation in rate of development to become pupa from larva.

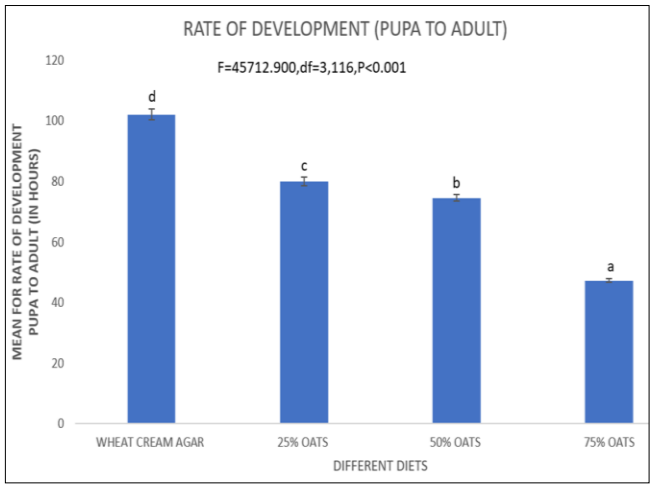

Fig 2: Effect of wheat cream agar medium and different concentrations of oats media on rate of development from pupa to adult in *Drosophila melanogaster*. (The different letter on the bar graph are indicates the significant variation in the different diet by the Tukey's post hoc test at 0.05 level).

The average and standard error values for the rate of pupa to adult development of *D. melanogaster* pupae are shown in Figure 2. pupae produced in wheat cream agar, 25% oats, 50% oats, and 75% oats media. This data showed that, larvae cultured in wheat cream agar media developmental rate slowed down but on increasing the concentrations from 25%, 50%, 75% oats media, there was quick developmental rate.

After One-way ANOVA, the Tukey post hoc test revealed a notable difference in the rate of development from pupa to adult across the different diets. Tukey's post hoc test revealed greater significant variation in wheat cream agar media, 25%, 50%, 75% oats media.

Effect of rolled oats on percentage of hatchability from larva to pupa in *D. melanogaster*.

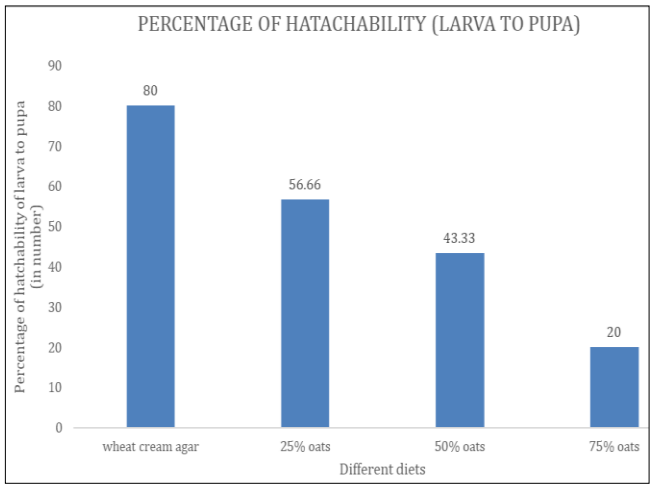

Fig 3: Effect of wheat cream agar medium and different concentration of oats media on percentage of hatchability from larva to pupa in *D. melanogaster*

Figure-3 showed the proportion of hatchability from larva to pupa for *D. melanogaster* larvae raised in the wheat cream agar media, 25% oats media, 50% oats media, and 75% oats media. According to the data collected, larvae reared on wheat cream agar media had a higher percentage of hatchability than 25%, 50%, and 75% oats media, where there was decreased hatchability percentage on gradually as the concentration of the dietary oats increased.

Effect of rolled oats on percentage of hatchability from pupa to adult in *D. melanogaster*.

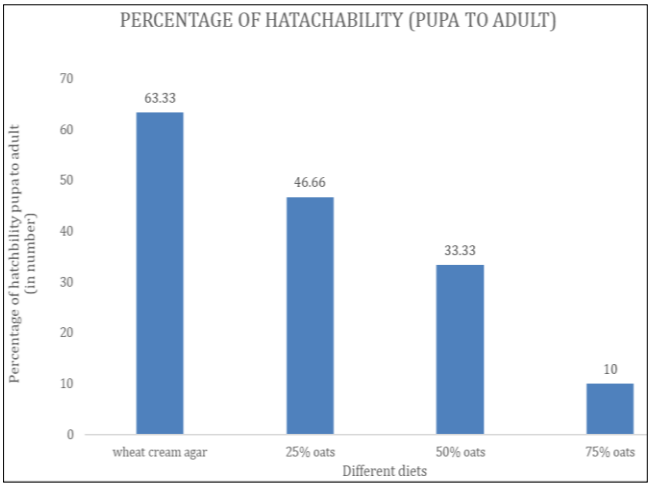

Fig 4: Effect of wheat cream agar diet on percentage of hatchability from pupa to adult in *D. melanogaster*

The proportion of *D. melanogaster* larvae that successfully hatched during the pupa-to-adult stage. Wheat cream agar media, 25% oats media, 50% oats media, and 75% oats media are shown in Figure 4. According to the data acquired, wheat cream agar media produced pupae with higher hatchability rates than 25%, 50%, and 75% oats media, as the concentration of the experimental diet increased, the hatchability percentage decreased gradually.

Discussion

Making dietary changes may increase fitness, as is widely acknowledged (Djawdan *et al*, 1998) [9]. Additionally, they demonstrated the increased egg to adult viability in sucrose-rich media as well as the beneficial impact of protein enrichment on female survival. As a result, it demonstrates that nutrition during the pre-adult years is crucial for the general health of the adult. The regulation of resource processing is also influenced by the varying levels of food that are accessible at these phases. Additionally, they showed that lower food intake causes smaller body size (Zoltan and Gerdien, 2003), which is a frequent phenomenon in ectotherms (Atkinson and Sibly, 1997) [2] and has been seen in *D. melanogaster* and other species (Gebhardt and Stearns, 1998) [12].

Figure 1 displays the growth rates from 1st instar larva to pupa on various concentrations of wheat cream agar and oats media. The data showed that the larva raised in oats media of higher concentration—25%, 50%, and 75%—had a much slower rate of development compared to the larva fed with wheat cream agar media. This could be because rolled oats include a high amount of dietary fiber, which can raise the viscosity of the digestive system and impair nutrient absorption and digestion (Xiaomei Dou *et al*., 2023 [10]; Prasad Rasane, 2013) [23]. The animals on the high-fiber diet grew considerably more slowly than the animals on the low-fiber diet. A diet with a lot of fiber reduces the digestibility of dry matter, protein, and fat (A. van Zyl,

1999) [30]. Higher fiber content, lower amino acids, lower electrolyte balance, and slowed pig growth rates were all brought about by a high fiber diet (Emma T Helm, 2021) [14]. The pace of development from pupa to adult on wheat cream agar and various oat media concentrations is depicted in Figure 2. The information gathered showed that the larva raised in oats media of higher concentration, from 25%, 50%, and 75% oats media, had a considerably faster rate of development than the larva fed with wheat cream agar media. This might be attributed to the high starch (carbohydrate) and protein content present in oats. The developmental rate is accelerated by a diet rich in carbohydrates and protein (Kiran K and Krishna M S, 2023) [17]. Carbohydrates are essential for animal growth because they provide energy and aid in other metabolic functions (Huantao Qu *et al*., 2022) [22]. Oat grain is composed of 60% starch, and it has a distinct protein makeup and high protein content (Prasad Rasane, 2013) [13].

Several variables influence the hatchability rates of *D. melanogaster*, including temperature, humidity, and genetic alterations. It is generally accepted that the speed of development (time between egg laying and eclosion) is a significant factor in an organism's pre-adult fitness, and that the two are highly correlated. The survival through the pre-adult phases determines the pre-adult viability. Therefore, analyzing developmental rate may also be used to assess viability (Bonnier *et al*, 1959) [6]. The pace of development in *Drosophila* slows as the temperature rises (Gilbert and De Jong, 2001; Hartwell *et al*, 2011). Variations in the percentage of hatchability are also impacted by changes in the external (physical) environment, such as light and temperature, according to numerous studies. However, in the current experiment, larvae and pupae were maintained under consistent laboratory settings while their diets were changed.

In our study, the result obtained (figure 3 and 4) shows that the percentage of hatchability from larvae to pupa was greater in wheat cream agar media, when compared to the different concentrations of oats media. On increasing the concentration of oats from 25%, 50%, and 75% oats media, there was gradually decreased percentage hatchability. And the same result was also obtained in hatchability percentage from pupa to adult too. Oats has a distinct protein makeup and high protein content (Prasad Rasane, 2013) [23]. Thus, due to hard digestibility of proteins present in oats hatchability percentage decreased gradually. Because of the diet's high protein content, it was challenging for the larvae to turn it into its metabolites (Manaswini D Kashyap *et al*., 2024) [16].

However, this indicates that the concentration of oats in the diet has a varied impact on the hatchability and growth rate of *D. melanogaster*. Thus, the rolled oats had a varied effect on pre adult fitness such as rate of development and percentage hatchability in *D. melanogaster*. All of these points are the fact that the quality and quantity of food in the diet have a significant impact on pre-adult fitness.

Conclusion

Changes in the percentage of hatchability and rate of development in *D. melanogaster* was showed by this study to be caused by differences in the quantity and quality of nutrition in the diet. Rolled oats of high concentration fed larvae exhibited a slower rate of development (larva to pupa), and faster rate of development (pupa to adult) and a lower percentage of hatchability. The progression from larva to pupa occurred at a rate of 75% oats medium > 50% oats medium > 25% oats medium > wheat cream agar medium. Wheat cream agar medium > 25% oats medium > 50% oats medium > 75% oats medium as it progressed from pupa to adult. And percentage of hatchability from larva to adult follows wheat cream agar medium > 25% oats > 50% oats media > 75% oats media. Hence this concludes that oats had varied impact on pre adult fitness in *D. melanogaster*.

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References

1. Alexander C, Krishna MS. Effect of avocado and yogurt on pre-adult development of Drosophila melanogaster. International Journal of Multidisciplinary Research and Development,2018:16(2):73–80.
2. Atkinson D, Sibly RM. Why are organisms usually bigger in colder environments? Making sense of a life history puzzle. International Journal of Multidisciplinary Research and Development,1997:16(2):73–80.
3. Aysha Barira HM, Anusree KA, Asniati Jabbar, Harshita L, Jashwanth G, Sadiya Sultana T, Krishna MS. The effect of mass gainer on the rate of development and percentage of hatchability in Drosophila melanogaster. International Journal of Multidisciplinary Research and Development,2024:16(2):73–80.
4. Bauerfeind SS, Fischer K. Effects of adult-derived carbohydrates, amino acids and micronutrients on female reproduction in a fruit-feeding butterfly. International Journal of Multidisciplinary Research and Development,2005:16(2):73–80.
5. Bochdanovits Z de Jong G. Experimental evolution in Drosophila melanogaster: Interaction of temperature and food quality selection regimes. International Journal of Multidisciplinary Research and Development,2003:16(2):73–80.
6. Bonnier G Jonsson UB, Ramel C. Experiments on the Effects of Homozygosity and Heterozygosity on the Rate of Development in Drosophila melanogaster. International Journal of Multidisciplinary Research and Development,1959:16(2):73–80.
7. Chown SL, Nicolson SW. Insect Physiological Ecology: Mechanisms and Patterns. International Journal of Multidisciplinary Research and Development,2004:16(2):73–80.
8. Cruz-Neto AP, Bozinovic F. The relationship between diet quality and basal metabolic rate in endotherms: insights from intraspecific analysis. International Journal of Multidisciplinary Research and Development,2004:16(2):73–80.
9. Djawdan M, Chippindale AK, Rose MR, Bradley TJ. Metabolic reserves and evolved stress resistance in Drosophila melanogaster. International Journal of

Multidisciplinary Research and Development,1998:16(2):73–80.
10. Dou X, Huang H, Li Y, Deng J, Tan B. Effects of dietary β-glucan on growth rate, antioxidant status, immune response, and resistance against Aeromonas hydrophila in genetic improvement of farmed tilapia (Oreochromis niloticus). International Journal of Multidisciplinary Research and Development,2023:16(2):73–80.
11. D'souza A, Krishna MS. Energy drinks' effect on pre-adult development of Drosophila melanogaster. International Journal of Multidisciplinary Research and Development,2015:16(2):73–80.
12. Gebhardt MD, Stearns SC. Reaction norms for developmental time and weight of eclosion in Drosophila mercatorum. International Journal of Multidisciplinary Research and Development,1988:16(2):73–80.
13. Geetha MS, Krishna MS. Effect of organic fruits (Chikku and Watermelon) on pre-adult fitness in Drosophila melanogaster. International Journal of Multidisciplinary Research and Development,2015:16(2):73–80.
14. Helm ET, Patience JF, Romoser MR, Johnson CD, Ross JW, Gabler NK. Evaluation of increased fiber, decreased amino acids, or decreased electrolyte balance as dietary approaches to slow finishing pig growth rates. International Journal of Multidisciplinary Research and Development,2021:16(2):73–80.
15. Hoffmann AA, Parsons PA. Evolutionary genetics and environmental stress. International Journal of Multidisciplinary Research and Development,1991:16(2):73–80.
16. Kashyap MD, Harshitha S, Darshini M, Naveenashree N, Purushotham MR, Darshan BK, Krishna MS. International Journal of Advanced Research in Biological Sciences. International Journal of Multidisciplinary Research and Development,2024:16(2):73–80.
17. Kiran K, Krishna MS. The effect of jeeni millets traditional mix on the pre-adult fitness in Drosophila melanogaster. International Journal of Multidisciplinary Research and Development,2023:16(2):73–80.
18. Koyama T, Texada MJ, Halberg KA, *et al*. Metabolism and growth adaptation to environmental conditions in Drosophila. International Journal of Multidisciplinary Research and Development,2020:16(2):73–80.
19. Lee KP, Simpson SJ, Wilson K. Dietary protein-quality influences melanization and immune function in an insect. International Journal of Multidisciplinary Research and Development,2008:16(2):73–80.
20. Mamba SS, Krishna MS. Effect of creatine monohydrate diet supplementation on the pre-adult fitness in Drosophila melanogaster. International Journal of Multidisciplinary Research and Development,2023:16(2):73–80.
21. Paudel D, Dhungana B, Caffe M, Krishnan PA review of health-beneficial properties of oats. International Journal of Multidisciplinary Research and Development,2021:16(2):73–80.
22. Qu H, Ke W, Wen Z, Guo B, Lu X, Zhao Y, *et al*., Effects of dietary carbohydrate on growth, feed utilization, hepatic glucose and lipid metabolism in endangered Yangtze sturgeon (Acipenser dabryanus). International Journal of Multidisciplinary Research and Development,2022:16(2):73–80.
23. Rasane P, Jha A, Sabiki L, Kumar A, Unnikrishnan VS. Nutritional advantages of oats and opportunities for its processing as value-added foods – a review. International Journal of Multidisciplinary Research and Development,2013:16(2):73–80.
24. Raubenheimer D, Simpson SJ. Integrating nutrition: a geometrical approach. International Journal of Multidisciplinary Research and Development,1999:16(2):73–80.
25. Rion S, Kawecki TJ. Evolutionary biology of starvation resistance: what we have learned from Drosophila. International Journal of Multidisciplinary Research and Development,2007:16(2):73–80.
26. Shreejani HK, Shreeraksha, Krishna MS. Effect of Spirulina on rate of development and percentage of hatchability in Drosophila melanogaster. International Journal of Multidisciplinary Research and Development,2023:16(2):73–80.
27. Shresta CM, Krishna MS. Effect of Prebiotics supplement on Pre-adult fitness in Drosophila melanogaster. International Journal of Multidisciplinary Research and Development,2023:16(2):73–80.
28. Sterner RW, Schulz KL. Zooplankton nutrition: recent progress and a reality check. International Journal of Multidisciplinary Research and Development,1998:16(2):73–80.
29. Taylor EN, Malawy MA, Browning DM, Lemar SV, DeNardo DF. Effects of food supplementation on the physiological ecology of female Western diamond-backed rattlesnakes (Crotalus atrox). International Journal of Multidisciplinary Research and Development,2005:16(2):73–80.
30. van Zyl A, Meyer AJ, van der Merwe M. The influence of fibre in the diet on growth rates and the digestibility of nutrients in the greater cane rat (Thryonomys swinderianus). International Journal of Multidisciplinary Research and Development,1999:16(2):73–80.
31. Wang L, Clark AG. Physiological genetics of the response to a high-sucrose diet by Drosophila melanogaster. International Journal of Multidisciplinary Research and Development,1995:16(2):73–80.