International Journal of Pharmacy and Biological Sciences-IJPBS™ (2019) 9 (2): 1280-1290
Online ISSN: 2230-7605, Print ISSN: 2321-3272
Research Article | Biological Sciences | Open Access | MCI Approved
UGC Approved Journal

# Impact of Dietary Restriction on Lifespan in Different Species of *Drosophila*

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Received: 10 Jan 2019 / Accepted: 9 Mar 2018 / Published online: 1 Apr 2019
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## Abstract
The present investigation was on the role of Dietary restriction in the lifespan of different species of *Drosophila*. *Drosophila melanogaster, Drosophila nasuta nasuta* and *Drosophila nasuta albomicans* were included in the study. Different combinations of diet were supplemented along with the standard wheat cream agar media in variable doses. *Drosophila* will be maintained at room temperature 22 ± 1°C with a relative humidity of 70%. Further following assessments were carried out. In this study, dietary restrictions (essential amino acids, proteins and carbohydrates) were evaluated for Lifespan in *Drosophila* species. As there is a decrease in longevity of control flies, one can assume that the additional dietary nutrients have an impact on extending lifespan. In addition to this irrespective of diet and concentrations the females have shown increased lifespan than males. The present investigation claims that protein plays essential role than carbohydrates or amino acid in determining the lifespan of *Drosophila* species. Further detailed study needed on the molecular impacts of Dietary restriction in *Drosophila*.

**Keywords**
*Drosophila* species; Dietary restriction; carbohydrate; amino acid; protein Longevity.

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## INTRODUCTION
Dietary restriction (DR), a reduction in the amount of food or particular nutrients eaten, is the most consistent environmental manipulation to extend lifespan and protect against age related diseases. Current evolutionary theory explains this effect as a shift in the resolution of the trade-off between lifespan and reproduction. However, recent studies have questioned the role of reproduction in mediating the effect of DR on longevity and no study has quantitatively investigated the effect of DR on reproduction across species (Joshua *et al.,* 2016). Dietary restriction (DR) refers to a moderate reduction of food intake that leads to extension of life span beyond that of normal, healthy individuals. This intervention has principally been studied in rodents, but it also extends the life span of a wide range of organisms including the fruit fly, *Drosophila melanogaster* (Magwere *et al.,* 2004). Animals and plants grow and reproduce surrounded by nutritional variation, where food is often scarce or key nutrients are lacking. Because the juvenile nutritional environment has major effects on the adult phenotype, linking nutrition and fitness is an increasingly important aspect of ecology, evolution

and life-history theories (Raubenheimer *et al.,* 2009; Morehouse *et al*., 2010).

The fruit fly *Drosophila* is a useful organism for the investigation of the mechanisms by which dietary restriction (DR) extends lifespan. Its relatively short generation time, well-characterized molecular biology, genetics and physiology and ease of handling for demographic analysis are all major strengths. Lifespan has been extended by DR applied to adult *Drosophila*, by restriction of the availability of live yeast or by co-ordinate dilution of the whole food medium. Lifespan increases to a maximum through DR with a progressive dilution of the food and then decreases through starvation as the food is diluted further. Daily and lifetime fecundities of females are reduced by food dilution throughout the DR and starvation range. Standard *Drosophila* food ingredients differ greatly between laboratories and fly stocks can differ in their responses to food dilution, and a full range of food concentrations should therefore be investigated when examining the response to DR. Flies do not alter the time that they spend feeding in response to DR (Patridge *et al.,* 2005).

The *Drosophila* genome has many homolog's with humans, e.g., 60% of human disease genes are shared with the fruit fly (Schneider, 2000). This genetic relationship between human and fly genetics facilitates the use of *Drosophila* to uncover mechanisms that improve human health and lifespan. Using *Drosophila* to study aging mechanisms will inform future interventions of human health, including the reduction of food intake.

When nutritional scarcity is encountered in an environment, reduced rates of senescence are often observed in animals, resulting in an extension in lifespan whilst reproductive effort is reduced or arrested (Weithoff, 2007; Carey et al., 2005). By avoiding the cost of reproduction and allocating available nutrients to somatic upkeep during unfavorable dietary conditions, organisms may improve their fitness by surviving until successful reproduction can begin or resume (Barrett et al., 2009). Nutrition has long been recognized as an important factor for influencing both the health span and lifespan in a variety of animals, including humans (Weindruch, 1982; Walford and Spindler, 1997). Thus, within the field of aging research, use of known nutritional interventions that act as anti-aging therapies are employed as a tool to better understand the biology of aging. One such intervention is Dietary Restriction (DR), a robust method for extending lifespan and promoting vitality which is applicable through a broad range of taxa from yeast to mammals.

Here, we demonstrate a system that allows measure DR in two allopatric races of *Drosophila* namely *Drosophila albomicans* (2n = 6) and *D. nasuta* (2n = 8) are 2 sibling species with indistinguishable morphology; but distinct karyotypes. *Drosophila albomicans* and *D. nasuta* belong to the *D. nasuta* subgroup of the *D. immigrans* species group. During the past years, numerous studies have shown that *D. nasuta* and *D. albomicans* have different chromosomal configurations (Wilson *et al.,* 1969, Nirmala and Krishnamurthy, 1972).

In the present study an attempt has been made to understand the DR regimes of three different species of *Drosophila* namely *Drosophila melanogaster, Drosophila nasuta nasuta* and *Drosophila nasuta albomicans* to record whether synergistic effect is seen in food intake during their survival period and also to tease apart the differences between the various dietary restriction paradigms with respect to lifespan in three species of *Drosophila* and also to test whether DR is independent of species.

## MATERIALS AND METHOD

### Fly stock

*Drosophila* culture was maintained using wheat cream agar media. The control stocks were cultured at 22±1$^0$C at 70% humidity in 12hr/12hr dark and light laboratory conditions. The experimental stocks were *Drosophila melanogaster*, *Drosophila nasuta nasuta and Drosophila nasuta albomicans*. The regular media was standardized with different doses of carbohydrates, proteins and amino acids (Min *et al.,* 2006). Tryptaphan and casein were dissolved in 0.1N NaOH. The standard culture was being used and the appropriate concentration of nutritional composition is as shown in Table 1 to Table 3. The flies exposed to variable diets were used to assess for longevity.

### Treatment

Different combinations of diet were supplemented along with the standard wheat cream agar media in variable doses. *Drosophila* will be maintained at room temperature 22 ± 1°C with a relative humidity of 70%. Further following assessments were carried out. In this study, dietary restrictions (essential amino acids, proteins and carbohydrates) were evaluated for Lifespan in *Drosophila* species.

**Table 1: - The regular media was standardized with different doses of Sucrose**

| Diet→ Comp↓ | Control media ↓ | Sucrose | | |
|---|---|---|---|---|
| | | Low dose | Mid dose | High dose |
| Distilled water | 1000ml | 1000ml | 1000ml | 1000ml |
| Agar agar | 10g | 10g | 10g | 10g |
| Soji | 100g | 100g | 100g | 100g |
| Sucrose | ----- | 20g | 40 g | 80 g |
| Jaggary | 100g | 100g | 100g | 100g |
| Propionic acid | 7.5ml | 7.5ml | 7.5ml | 7.5ml |

**Table 2: - The regular media was standardized with different doses of Tryptophan**

| Diet→ Comp↓ | Control media ↓ | Sucrose | | |
|---|---|---|---|---|
| | | Low dose | Mid dose | High dose |
| Distilled water | 1000ml | 1000ml | 1000ml | 1000ml |
| Agar agar | 10g | 10g | 10g | 10g |
| Soji | 100g | 100g | 100g | 100g |
| Tryptophane | ----- | 250mg | 500mg | 750mg |
| Jaggary | 100g | 100g | 100g | 100g |
| Propionic acid | 7.5ml | 7.5ml | 7.5ml | 7.5ml |

**Table 3: - The regular media was standardized with different doses of Casein**

| Diet→ Comp↓ | Control media ↓ | Sucrose | | |
|---|---|---|---|---|
| | | Low dose | Mid dose | High dose |
| Distilled water | 1000ml | 1000ml | 1000ml | 1000ml |
| Agar agar | 10g | 10g | 10g | 10g |
| Soji | 100g | 100g | 100g | 100g |
| Casein | ----- | 2.5g | 5.0 g | 7.5 g |
| Jaggary | 100g | 100g | 100g | 100g |
| Propionic acid | 7.5ml | 7.5ml | 7.5ml | 7.5ml |

**Record the role of diet on longevity**

Longevity was assessed using the modified protocol of Luckinbill and Clare (1985). Simultaneously along with the lifetime fecundity and fertility the same set of flies were continued to assess the longevity. Each vial was observed daily from day of emergence to record the lifespan.

**RESULTS**

To record the role of diet on longevity in *Drosophila melanogaster, Drosophila nasuta nasuta and Drosophila albomicans*

***Drosophila melanogaster***

The mean longevity of *Drosophila melanogaster* on exposure to different diet with varied concentrations of sucrose, casein and tryptophan. The mean longevity of *D.melanogaster* male and female fed with different concentrations of sucrose have shown significant increased longevity high dose 35±2.09 and 41±2.18 respectively. While in the males have shown significantly decreased has shown significantly decreased longevity (30±2.43) than the other concentrations as shown in **Table 4a.** Similarly, the mean longevity of both males and females fed with high dose of casein have shown significantly increased longevity with the mean of 41±2.09 and 44±2.12 respectively. While the control flies have shown significantly decreased longevity than the other concentrations. Interestingly even in the tryptophan diet also the longevity was increased in high dose than the other concentrations and the control flies have shown decreased longevity. The differences between control and LD of tryptophan diet are insignificant which was evicted in **Figure 1a**.

***Drosophila nasuta nasuta***

In case of *Drosophila nasuta nasuta* fed with different diets in varied concentrations of sucrose, casein and tryptophan. The mean longevity of *Drosophila nasuta nasuta* fed with different concentrations of sucrose has revealed that the Male (42±2.12) and female (45±2.09) fed with high dose have shown significantly increased longevity than the flies fed with control, LD, MD respectively. While the control of male (35±1.98) and female (40±2.31) have shown significantly decreased longevity than the other concentrations (**Table 4b**). In addition to this in

the casein diet also the mean longevity of males (45±2.18) and females (51±2.09) have shown significantly increased longevity with increased dose concentration. Subsequently the tryptophan fed flies have shown increased longevity in male (40±2.18) and female (43±2.09) at higher dose, and in the control male and LD females have shown decreased longevity in **Figure 1b**.

***Drosophila nasuta albomicans***

The mean longevity of *D.n.albomicans* on exposure to different diet with varied concentrations of sucrose, casein and tryptophan. The mean longevity of *Drosophila nasuta albomicans* fed with different concentrations of sucrose, casein and tryptophan have revealed that the higher dose fed flies have showed significantly increased longevity shown in **Table 4c**. While the control has shown significantly decreased longevity in both males and females (**Figure 1c**).

**Species wise comparison**

Figure 2 reveals the overall mean longevity of all the species fed with varied concentration diets. *D.n.nasuta* has shown increased longevity (45±2.43) followed by *D.n.albomicans* and *D.melanogaster* with df=2; F=23.56; P<0.05 (**Table 4d**).

**Diet wise comparison**

The mean longevity of males and females of three species fed with three different dietary media. In general, the females of all the species irrespective of the diet have shown increased longevity than males (**Figure 3**). The flies fed with casein diet have shown increased longevity followed by tryptophan and sucrose, but the differences between tryptophan and sucrose in both males and females are insignificant with df=2; F=101.97; p<0.05 (**Table 4d**).

**Concentration of the diet**

**Figure 4** The overall mean longevity with respect to concentration have shown increased longevity with increased concentration of all the experimental diets, while the control has decreased longevity, but the differences are insignificant between control and LD with df=3; F=212.19; P<0.05. (Table 4d).

**Species vs Diet wise comparison**

**Figure 5** provides the overall mean longevity of three different species of *Drosophila* fed with different diets. *D.n.nasuta* has shown increased longevity followed by *D.n.albomicans* and *D.melanogaster*. in addition to this the flies fed with tryptophan have shown decreased longevity in compilation with the other diets with df= 4; F=45.16; P<0.05 (**Table 8D**).

**Species vs Concentration wise comparison**

The increase concentration is directly proportional to increased longevity in all the species of the present study with df = 6 F= 30.14; P<0.05 (**Table 8D**) and (**Figure 6)**

**Diet vs Concentrations**

**Figure 7** denotes that longevity has shown to increase in HD with respect all the diets and found to be decreased in control with df= 6, F=14.06; P<0.05 (**Table 8D**).

**Diet Vs Species Vs Concentration**

**Figure 8** reveals that the multiple concentrations between diet, species and concentration. Irrespective of the species the casein fed flies have shown increased longevity than sucrose and tryptophan. In case sucrose fed flies of *D.melanogaster* has shown decreased longevity than the other two species. While the differences are insignificant between *D.n.nasuta* and *D.n.albomicans* which have shown increased longevity with df= 12 F= 7.85 P<0.05(**Table 8D**).

**Table 4a: Mean (±SE) Longevity of *Drosophila melanogaster*s fed with different concentrations of Sucrose, casein and tryptophan**

| ***Drosophila melanogaster*** | | | | | | |
|---|---|---|---|---|---|---|
| **Concentration** | **Sucrose** | | **casein** | | **Tryptophan** | |
| | **Male** | **Female** | **Male** | **Female** | **Male** | **Female** |
| **Control** | 33.1±2.31 **a** | 36±2.56 **a** | 33.1±2.31 **a** | 36±1.98 **a** | 33.1±2.31 **a** | 36±2.56 **a** |
| **LD** | 30±2.43 **b** | 37±2.35 **ab** | 36±2.43 **b** | 41±2.01 **b** | 32±2.43 **a** | 38±2.35 **b** |
| **MD** | 34±1.98 **ac** | 38±2.63 **cb** | 39±1.98 **c** | 42±2.56 **b** | 35±1.98 **b** | 40±2.63 **c** |
| **HD** | 35±2.09 **dc** | 41±2.18 **d** | 41±2.09 **d** | 44±2.12 **c** | 38±2.09 **c** | 41±2.18 **c** |
| **ANOVA** | F=87,df= 198 P<0.05 | F=34,df= 58 P<0.05 | F=58,df= 231P<0.05 | F=42,df= 176 P<0.05 | F=112,df= 213 P<0.05 | F=61,df= 190 P<0.05 |

**Note: Means in each column followed by different alphabetical letter within the same life stage were significantly different by Tukey HSD (P<0.05)**

**Table 4b: Mean (±SE) Longevity of *Drosophila nasuta nasuta* flies fed with different concentrations of Sucrose, casein and tryptophan**

| ***Drosophila nasuta nasuta*** | | | | | | |
|---|---|---|---|---|---|---|
| **Concentration** | **Sucrose** | | **casein** | | **Tryptophan** | |
| | **Male** | **Female** | **Male** | **Female** | **Male** | **Female** |
| **Control** | 35±1.98 **a** | 40±2.31 **a** | 35±2.56 **a** | 40±2.31 **a** | 35±2.56 **a** | 40±2.31 **a** |
| **LD** | 38±2.01 **b** | 42±2.43 **b** | 41±2.35 **b** | 43±2.43 **b** | 37±2.35 **b** | 38±2.43 **b** |
| **MD** | 39±2.56 **b** | 44±1.98 **c** | 43±2.63 **c** | 45±1.98 **c** | 36±2.63 **b** | 39±1.98 **b** |
| **HD** | 42±2.12 **c** | 45±2.09 **c** | 45±2.18 **d** | 51±2.09 **d** | 40±2.18 **c** | 43±2.09 **c** |
| **ANOVA** | F=71,df= 156 P<0.05 | F=58,df=185 P<0.05 | F=49,df= 214P<0.05 | F=38,df= 163P<0.05 | F=75,df= 181 P<0.05 | F=56,df= 254 P<0.05 |

**Note: Means in each column followed by different alphabetical letter with in the same life stage were significantly different by Tukey HSD (P<0.05)**

**Table 4c: Mean (±SE) Longevity of *Drosophila nasuta albomicans* flies fed with different concentrations of Sucrose, casein and tryptophan.**

| ***Drosophila nasuta albomicans*** | | | | | | |
|---|---|---|---|---|---|---|
| **Concentration** | **Sucrose** | | **casein** | | **Tryptophan** | |
| | **Male** | **Female** | **Male** | **Female** | **Male** | **Female** |
| **Control** | 32±1.98 **a** | 38±2.31 **a** | 32±2.56 **a** | 38±1.98 **a** | 32±2.31 **a** | 38±2.56 **a** |
| **LD** | 35±2.01 **b** | 37±2.43 **a** | 41±2.35 **b** | 43±2.01 **b** | 34±2.43 **b** | 39±2.35 **ab** |
| **MD** | 37±2.56 **c** | 40±1.98 **b** | 42±2.63 **b** | 45±2.56 **c** | 38±1.98 **c** | 40±2.63 **ba** |
| **HD** | 39±2.12 **d** | 41±2.09 **b** | 44±2.18 **c** | 46±2.12 **c** | 41±2.09 **d** | 42±2.18 **c** |
| **ANOVA** | F=32,df= 168 P<0.05 | F=48,df= 175 P<0.05 | F=72,df= 112P<0.05 | F=57,df= 198P<0.05 | F=176,df= 320P<0.05 | F=123,df= 234 P<0.05 |

**Note: Means in each column followed by different alphabetical letter with in the same life stage were significantly different by Tukey HSD (P<0.05)**

**Table 4d: Three-way ANOVA of longevity of three species, three diets and three concentrations along with control**

| **Source** | **Type III Sum of Squares** | **df** | **Mean Square** | **F** | **Sig.** |
|---|---|---|---|---|---|
| Corrected Model | 50179.837[a] | 71 | 706.758 | 29.868 | .000 |
| Intercept | 3549422.963 | 1 | 3549422.963 | 150002.331 | .000 |
| Species | 1115.093 | 2 | 557.546 | 23.562 | .000 |
| Diet | 4825.701 | 2 | 2412.850 | 101.970 | .000 |
| Concentration | 15063.441 | 3 | 5021.147 | 212.199 | .000 |
| Species * Diet | 4274.735 | 4 | 1068.684 | 45.164 | .000 |
| Species * Concentration | 4279.381 | 6 | 713.230 | 30.142 | .000 |
| Diet * Concentration | 1996.440 | 6 | 332.740 | 14.062 | .000 |
| Species * Diet * Concentration | 2230.880 | 12 | 185.907 | 7.857 | .000 |
| Error | 49407.200 | 2088 | 23.662 | | |
| Total | 3649010.000 | 2160 | | | |
| Corrected Total | 99587.037 | 2159 | | | |

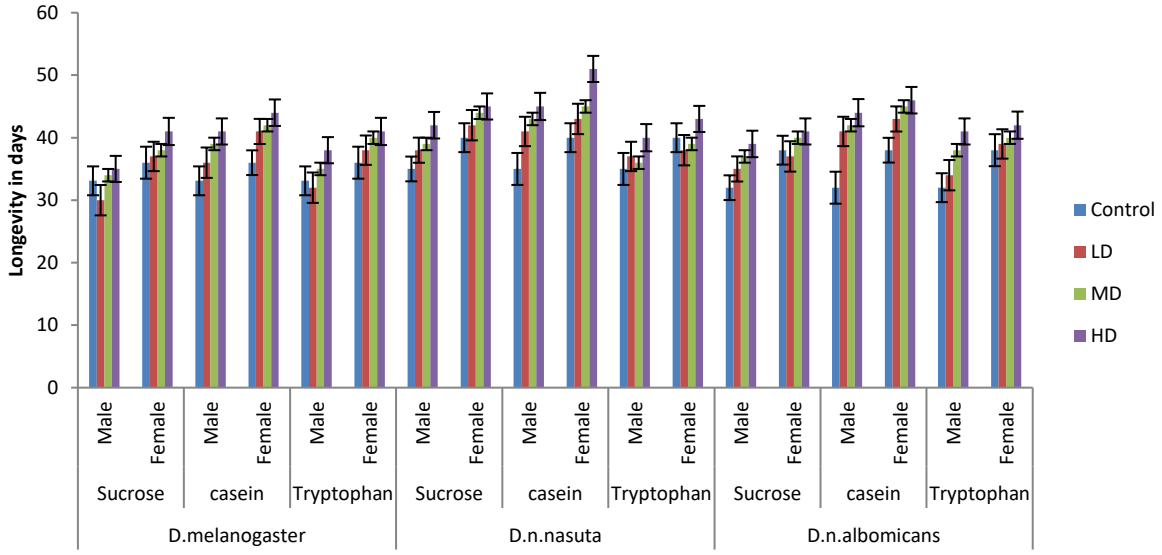


**Figure 1a: Mean (±SE) Longevity of *D.melanogaster, D.n.nasuta* and *D.n.albomicans* flies fed with different concentrations of Sucrose, casein and tryptophan.**

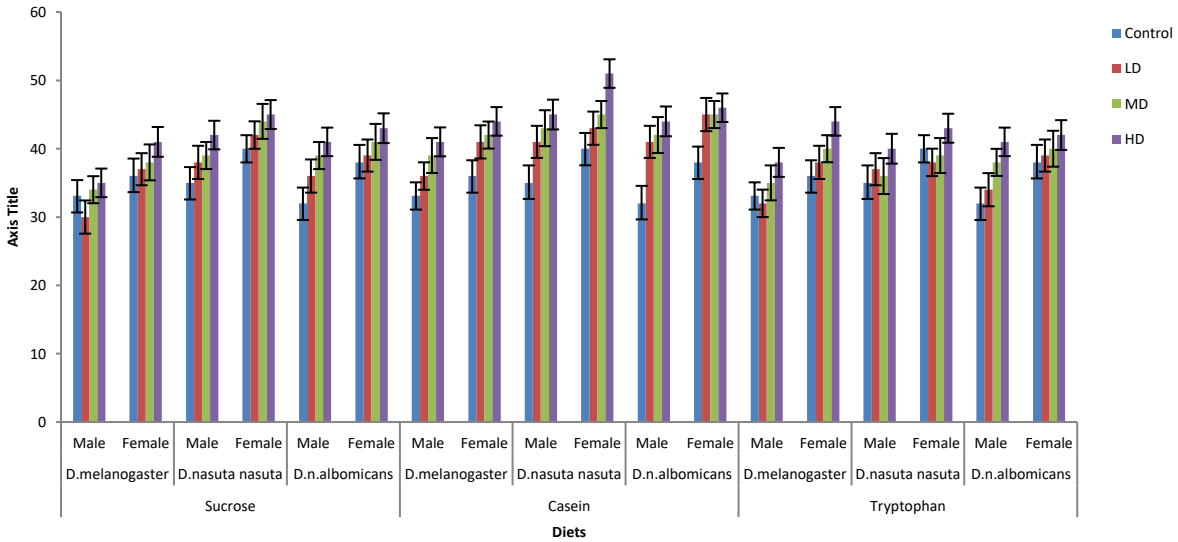


**Figure 1b: Mean (±SE) Longevity of *D.melanogaster, D.n.nasuta* and *D.n.albomicans* flies fed with different diet**

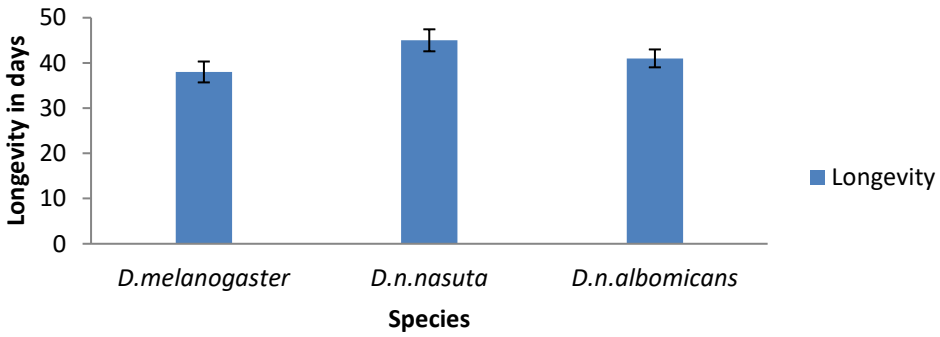


**Figure 2: Mean (±SE) Longevity of *D.melanogaster, D.n.nasuta and D.n.albomicans***

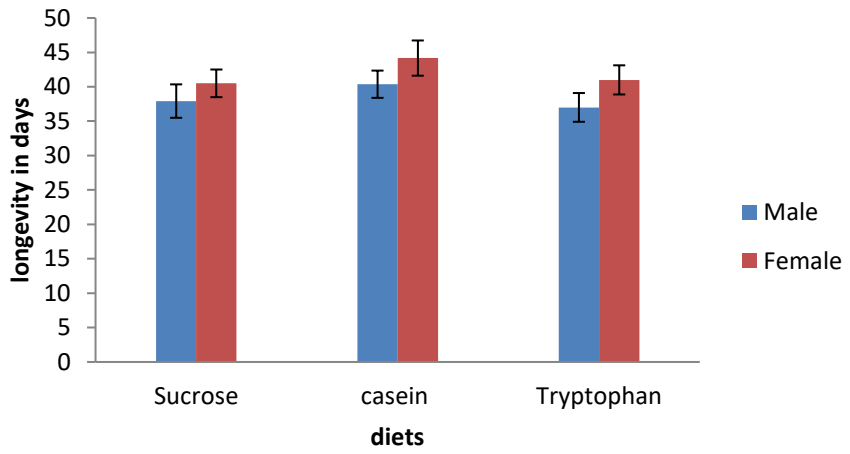


**Figure 3: Mean (±SE) Longevity of male and female flies fed with different diets**

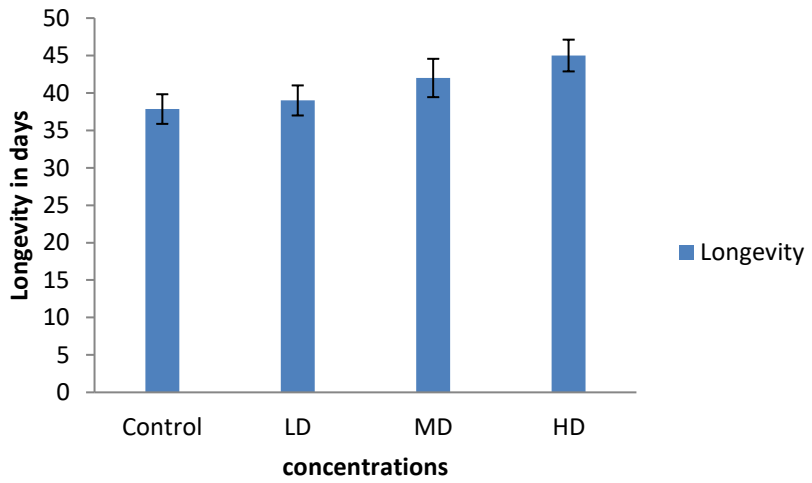


**Figure 4: Mean (±SE) Longevity of flies fed with different concentrations**

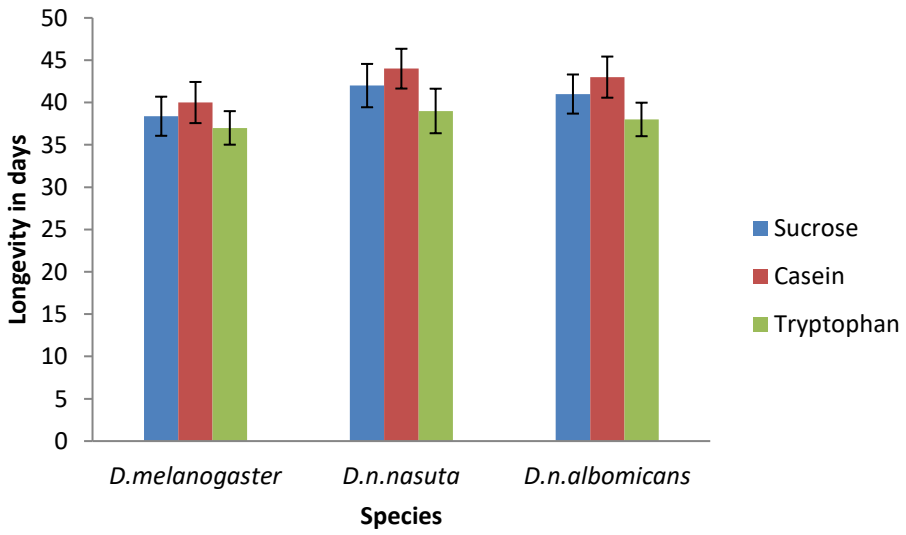


**Figure 5: Average mean (±SE) Longevity of three species of flies fed with different diets**

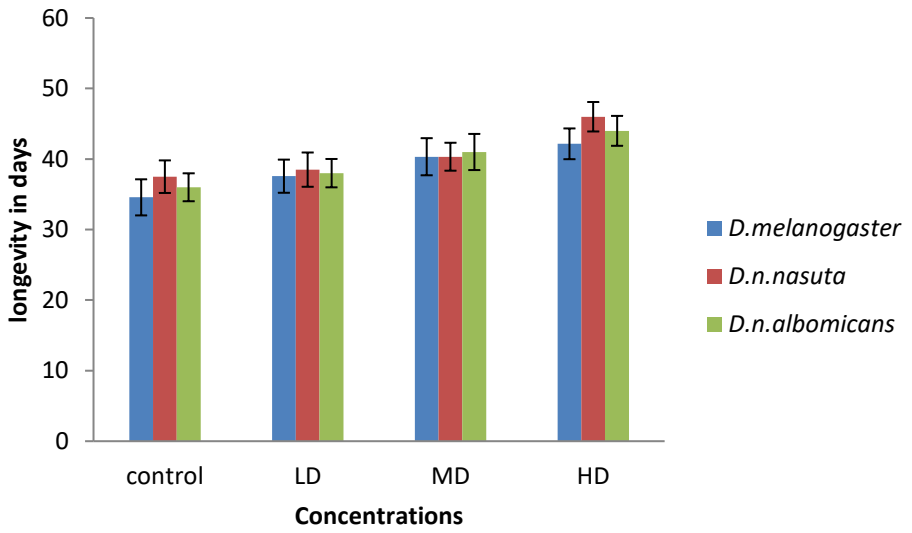


**Figure 6: Mean (±SE) Longevity of flies fed with different concentrations**

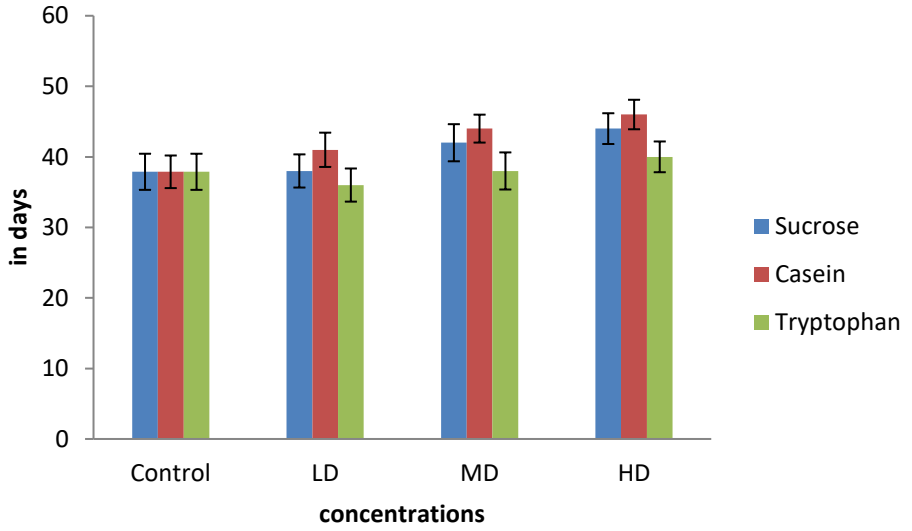


**Figure 7: Mean (±SE) Longevity of flies fed with different concentration with varied diets**

**DISCUSSION**

Dietary restriction (DR), the extension of life span by reduction of nutrient intake without malnutrition is often used as a benchmark comparison for interventions that extend life span (Masoro, 2002). Since McCay's pioneering experiments in rats 70 years ago (McCay *et al.,* 1935), some form of food restriction has been shown to increase life span in commonly used model organisms such as nematodes (Klass, 1977), fruit flies (Chippindale *et al.,* 1993; Chapman and Partridge, 1996), and mice (Weindruch and Walford, 1982), along with many species less often used for laboratory research such as water fleas, spiders, fish (Weindruch and Walford, 1988). Although it is fairly well-established that dietary restriction (DR) can affect longevity in many animals (Fontana *et al.,* 2010), methods used to implement DR vary greatly across model organisms. Nutritional environment is a potent mediator of an organism lifespan, in particular dietary restriction has been constantly found to extend lifespan across a vast range of animal taxa including Yeast (Lin *et al*., 2002), Fruit flies ( Chippidale *et al*., 1993), Mice (Weindruch and walford, 1982). The influence of distinct carbohydrates on ageing has previously been tested for several different model organisms, including the fruit fly *Drosophila melanogaster* (Diptera: *Drosophilidae*). Despite the finding that restricting diet increases longevity in such a diversity of species, the mechanisms responsible remain to be fully

elucidated in any of them. It is therefore as yet unclear whether these mechanisms are evolutionarily conserved across taxa or if instead life extension during DR is an example of convergent evolution. Flies fed food media with very similar caloric content showed marked differences in their life spans. This finding is in direct contrast to what would be predicted if ingested calories were the key mediator of life span in *D. melanogaster* and demonstrates that the nutritional composition of the diet affects life-span extension by DR in this species.

Since many of the core metabolic and molecular mechanisms involved in the response to DR are highly conserved, *Drosophila* has become an extensively used model to investigate the interaction between nutrition and lifespan. In the fruit fly, the effect of individual nutrients on lifespan remains less clear (Kimberley *et al.,* 2013). In view of this the present study has been structured to access the interaction between diet influences on different species of *Drosophila*. Dietary restriction as immense impact on life span across different species of *Drosophila* taxa, but the key nutritional components driving this process and their interaction remains indecisive. In the present study different species of *Drosophila* have shown substantial affects on the longevity with the allocated dietary component such as sucrose, casein and tryptophan. Several studies have been demonstrated that increased intake of protein may increase protein synthesis, decrease protein breakdown, reduce fat accumulation, and increase fat-free mass (Kerksick *et al*., 2006) has been demonstrated. Therefore, protein supplementation or a high-protein diet (HPD) is recommended to build the muscle in athletes, to prevent muscle wasting in severe illness, and to lose the fat in treatment of obesity. The most popular forms of protein supplements are milk proteins, whey and casein. Casein, which makes up approximately 80% of the milk protein, is considered ‘‘slow’’ protein because, in comparison with whey protein, is emptied from stomach more slowly and amino acids from casein appear in the blood more slowly, and the response lasts longer. It is believed that while whey protein affects protein balance mostly by stimulation of protein synthesis, casein works to decrease protein breakdown (Boirie *et al*., 1997). The multiple concentrations between diet, species and concentration. Irrespective of the species the casein fed flies have shown increased longevity than sucrose and tryptophan. In case sucrose fed flies of *D.melanogaster* has shown decreased longevity than the other two species. While the differences are insignificant between *D.n.nasuta* and *D.n.albomicans* which have shown increased longevity with df= 12 F= 7.85 P<0.05**(Table 4d**).

However, the effect of carbohydrate diets, and particularly the type of carbohydrate, as well as the protein-to-carbohydrate ratio on reproduction and life span are poorly investigated and generally studied in comparatively simple organisms like *Drosophila melanogaster*, which is intensively used as a model for nutritional studies. Over the last decade, several studies explored the effect of diet on life span, reproduction, behaviour, and adaptation of fruit flies (Vigne and Frelin, 2010).

Casein contains high proportions of all essential amino acids and high amounts of glutamine and proline but, in comparison with blood meal, provides relatively low amounts of glycine and cysteine (Li *et al*., 2011). Therefore, it may be suggested that chronic intake of high amounts of casein may induce the imbalance in amino acid concentration in body fluids. This may affect a number of biochemical pathways, susceptibility to oxidative damage, and the response of the body to different physiological and pathological conditions, such as starvation or illness. There is scarce information available on how nutrition affects life history traits in *Drosophila*. The importance of diet is often underestimated in experimental design (Prasad *et al*., 2003).

Studies have revealed that Carbohydrates are important dietary components for many omnivorous and herbivorous animals, including both humans and livestock. Carbohydrates provide energy for many reactions and processes flowing inside cells. Most organisms can tightly adjust their metabolism according to the availability of dietary components, including carbohydrates. Physiological effects of carbohydrates depend on their type and dosage, as well as on the physiological state of an organism (Wheeler and Pi-sunver, 2008). Very low carbohydrate intake restricts an organism’s available energy and may slow down growth and regeneration, thereby altering survival and health. However, low carbohydrate intake has been proposed as a possible intervention to decrease the risk of, and complications related to, metabolic diseases such as obesity and metabolic syndrome (Giugliano *et al*., 2008).

The present investigation claims that protein (casein) plays a central role followed by carbohydrates (sucrose) and amino acid (tryptophan). Carbohydrate and amino acid are also found to be equivocal in determining the lifespan of *Drosophila melanogaster, D.nasuta nasuta* and *Drosophila nasuta albomicans*. For further clarification a series

of diets with varying sucrose, casein and tryptophan content were fed to record how nutritional factors influence longevity. But one cannot always expect increased dietary protein, carbohydrate or amino acid concentration does not always result in increased longevity. Henceforth, as there is a decrease in longevity of control flies, one can assume that the additional dietary nutrients have a role on extending lifespan.

Newly evolved allopatric races namely *D.nasuta nasuta* and *Drosophila nasuta albomicans* have shown increased longevity than *D.melanogaster.* The ancestral species ie *D.melanogaster* as decreased longevity when compared to the newly evolved races, which imbibes that the newly evolved species flourish well with extended lifespan on consuming varied nutritional diets rather than the regular food media. Thereby the ''Dietary stress is a factor causing a change in the biological system, which is potentially detrimental''. Lifespan is resolute largely by the stressful conditions, the severity of the stress and the organism's ability to cope with it is very important for its survival.

## CONCLUSION

The present investigation claims that protein plays essential role than carbohydrates or amino acid in determining the lifespan of *Drosophila* species. It is also proven by the study that longevity is decreased in control flies compared to additional nutrient fed flies, thus supplementary dietary nutrients have an impact on extending lifespan. In addition to this irrespective of diet and concentrations the females have revealed augmented lifespan than males. However, the relation between physiological and evolutionary trade-offs are not similar, and physiological trade-offs might not translate into trade-off at the population level. When the expression of the physiological trade-off is genetically variable among individuals in the population, it may contribute to an evolutionary trade-off and thus explicate varied response to reproductive and lifespan in different species of *Drosophila*. In light of this, we apparently emphasize the importance of protein intake for optimal life history trade-offs for improved survivability in different species of *Drosophila*.

## Conflict of Interest

None

## REFERENCES

Barrett E.L.B, Moore A.J and Moore P.J. 2009. Diet and social conditions during sexual maturation have unpredictable influences on female life history trade-offs. *Journal of Evolutionary Biology*. 22:571–581.

Carey J.R, Harshman L.G and Liedo P. 2005. Longevity-fertility trade-offs in the tephritid fruit fly, *Anastrepha ludens,* across dietary-restriction gradients. *Aging Cell*. 7:470–477.

Chapman T and Partridge L. 1996. Female fitness in *Drosophila melanogaster:* An interaction between the effect of nutrition and of encounter rate with males. *Proc R Soc Lond B Biol Sci.* 263: 755–59.

Chippindale A.K, Leroi A.M, Kim S.B and Rose M.R. 1993. Phenotypic plasticity and selection in *Drosophila* life-history evolution, Nutrition and the cost of reproduction. *J. Evol. Biol.* 6:171–193.

Fontana A.L, Partridge L, Valter D. and Longo R. 2010. Extending healthy life span—from yeast to humans. *Science,* 328(5976) : 321-326.

Joshua P.M.P, Shinichi N, Malgorzata L and Craig A.W. 2016. The effect of dietary restriction on reproduction: a meta-analytic perspective. BMC Evolutionary Biology 16:181-199.

Klass M.R 1977. Ageing in the nematode *Caenorhabditis elegans*: major biological and environmental factors influencing life span. *Mech Ageing Dev.* 6:413–429.

Li H, Dong Y, Yin H, Wang N, Yang J, Liu X, Wang Y, Wu J and Li. 2011. Characterization of the stress associated microRNAs in Glycine max by deep sequencing. *BMC Plant Biol.* doi: 10.1186/1471-2229-11-170.

Magwere T, Chapman T and Partridge L. 2004. Sex differences in the effect of dietary restriction on life span and mortality rates in female and male *Drosophila melanogaster*. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*. 59: B3–B9.

Masoro E.J. 2003. Subfield history: caloric restriction, slowing aging, and extending life. *Sci. Aging Knowl. Environ.* RE2. 328:63 – 68.

McCay C.M, Crowell M.F and Maynard L.A. 1935. The effect of retarded growth upon the length of life span and upon the ultimate body size. *Nutrition.* 5(3):155-171.

Min K.J and Tatar M. 2006. Restriction of amino acids extends lifespan in *Drosophila melanogaster*. *Mech. Ageing Dev*. 127: 643–646.

Morehouse N.I, Nakazawa T, Booher C.M, Jeyasingh P.D and Hall M.D. 2010. Sex in a material world: Why the study of sexual reproduction and sex-specific traits should become more nutritionally explicit. *Oikos*. 119; 766–778.

Nirmala S.S and Krishnamurthy N.B. 1973. *Drosophila neonasuta,* A new species of *Drosophila* from Mysore. (Diptera: *Drosophilidae*). *Oriental Insects.* 7 (2):267-270.

Partridge L, Piper M.D and Mair W. 2005. Dietary restriction in *Drosophila*. *Mech. Ageing Dev*. 126(9):938-950.

Raubenheimer D, Simpson S.J and Mayntz D. 2009. Nutrition, ecology and nutritional ecology: toward an integrated framework. *Functional Ecology*. 23:4–16.

Schneider D. 2000. Using *Drosophila* as a model insect. *Nat Rev Genet.* 1:218-226.

Walford R.L and Spindler S.R. 1997. The response to calorie restriction in mammals shows features also common to hibernation—a cross-adaptation hypothesis. *Journal of Gerontology.* 52:179 – 183.

Weindruch R and Walford R.L. 1982. Dietary restriction in mice begining at one year of age: Effect on life span and spontaneous cancer incidence. *Science*. 215:1415–1421.

Weindruch R and Walford R.L. 1988.The retardation of aging and disease by dietary restriction *Journal of Gerontology.* 241:324-328.

Weithoff G. 2007 Dietary restriction in two rotifer species: the effect of the length of food deprivation on life span and reproduction. *Oecologia.* 153:303–308.

Wilson F.D, Wheeler M.R, Harget M and Kambysellis. 1969. Cytogenetics relations in the *Drosophila nasuta* subgroup of species. *Univ. Texas Publ.* 6918:207-254.