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ARAŞTIRMA MAKALESİ **RESEARCH PAPER**

The Effects of Propolis on the Developmental Stages and Biochemıcal Composıtion of *Musca Domestica* Linnaeus, 1758 (Diptera: Muscidae)

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Abstract: The housefly (*Musca domestica L.)* is well known as a global pest of animals and humans. The houseflies contain high purity chitin and protein and these widely used in industry and medicine. Their larvae have the ability to produce animal protein through the biodegradation of organic waste. House flies provide an alternative for recycling nutrients while also generating multiple income streams, so their large-scale production is important. This study investigates the impacts of four different propolis on some life history traits and protein, carbohydrate, and lipid content of *M. domestica.*

Groups of 30 newly hatched *M. domestica* larvae were transferred to a polyethylene cup filled diet with different concentration of propolis and kept at 25.6 ± 0.8°C, 62% RH and a photoperiod of 12:12 (L:D). One-way ANOVA was used to compare life history and biochemical parameters. The results showed that increasing concentrations of propolis reduced larval length and weight. We observed a decrease in the number of pupae and adults but noted a significant increase in pupal weight. Propolis diets did not affect the larval development time compared to the control, but they did shorten the pupal development time. In presentt study, increasing propolis concentrations increased carbohydrate content and decreased lipid amount of *M. domestica* larvae compared to the control

Keywords: Biochemical composition, developmental stages, *Musca domestica*, propolis.

Propolisin *Musca domestica* Lınnaeus, 1758 (Dıptera: Muscıdae)'nın Gelişim Evreleri ve Biyokimyasal Kompozisyonu Üzerine Etkileri

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Öz: Ev sineği (*Musca domestica L.*), hayvanlar ve insanlar için küresel bir zararlı olarak bilinir. Ev sinekleri, yüksek saflıkta kitin ve protein içerir ve bu maddeler endüstri ve tıp alanında yaygın olarak kullanılmaktadır. Larvaları, organik atıkların biyolojik bozunumu yoluyla hayvansal protein üretme yeteneğine sahiptir. Ev sinekleri, besinlerin geri dönüşümü için bir alternatif sunarken aynı zamanda birden fazla gelir kaynağı oluşturarak ekonomik katkı sağlar. Bu nedenle, büyük ölçekli üretimleri önemlidir. Bu çalışma, dört farklı propolisin bazı yaşam öyküsü özellikleri ile *M. domestica*'nın protein, karbonhidrat ve lipid içeriği üzerindeki etkilerini incelemektedir.

Yeni çıkan 30 adet *M. domestica* larvası, farklı konsantrasyonlarda propolis içeren bir diyet ile doldurulmuş polietilen kaplara aktarılmış ve 25,6 ± 0,8°C, %62 bağıl nem ve 12:12 (L:D) fotoperiyot koşullarında tutulmuştur. Yaşam öyküsü ve biyokimyasal parametrelerin karşılaştırılması için tek yönlü ANOVA kullanılmıştır. Sonuçlar, artan propolis konsantrasyonlarının larva uzunluğu ve ağırlığını azalttığını göstermiştir. Pupa ve yetişkin sayısında bir azalma gözlemlenirken, pupa ağırlığında anlamlı bir artış kaydedilmiştir. Propolis diyetleri, kontrol grubuna kıyasla larval gelişim süresini etkilememiş ancak pupal gelişim süresini kısaltmıştır. Bu çalışmada, artan propolis konsantrasyonlarının larvaların karbonhidrat içeriğini artırdığı, lipid miktarını ise azalttığı tespit edilmiştir.

Anahtar kelimeler: Biyokimyasal kompozisyon, *Musca domestica*, gelişim evreleri, propolis.

INTRODUCTION

Honeybees collect propolis, is a natural resin collected from plant exudates and used to protect and sterilize the hive. (Hepşen et al., 1996; Geçkil et al., 2005) It acts as a protective barrier against bacteria, fungi, and other harmful agents within the hive. (Garedew et al., 2002; Simone-Finstrom et al., 2017)

The color of propolis ranges from yellow to dark brown, and it is water-insoluble with a semi-solid, sticky consistency. (Almeida and Menezes, 2002; Gulhan, 2009) Propolis contains more than 300 identified compounds, including polyphenols, alcohols, acids, terpenoids, steroids, sugars, and amino acids. (Marruci, 1995; Hepşen et al., 1996). The pharmaceutical, cosmetic, and food industries widely use propolis due to its rich composition (Ghisalberti, 1979; Marruci, 1995; Gekkeret al., 2005; Nirala ve Bhadauria, 2008; Sforcin, 2016; Touzani et al., 2021)

Additionally, the properties of propolis are noteworthy in applications such as increasing biomass in insects. The nutrients and natural components found in propolis can positively affect insect development and growth performance. Therefore, propolis has potential for enhancing efficiency in insect farming, particularly in biomass production. These properties make propolis valuable not only in health applications but also for improving insect growth performance, providing it with a broad range of uses (İtavo et al., 2011; Kinasihet al., 2018; Bakaakiet al., 2023). Propolis has immune stimulating effects and improves the productivity and growth performance of poultry (Zafarnejad et al., 2017; Denli et al., 2005; Subha et al., 2010). In the meantime, propolis increases growth in poultry due to its potential to regulate gastrointestinal microbiota (Kacaniova, *et al*., 2012).

The housefly (*Musca domestica*) and its relatives are medium to small-sized dipterans commonly found in various aquatic and terrestrial habitats, excluding arid environments. (Skidmore, 1985) These insects can carry pathogens and harmful substances, particularly around garbage, dung, livestock farms, and humans, posing potential health and hygiene risks. (Scott et al., 2009; Greenberg, 2019) However, the contribution of *M. domestica* to the organic decomposition cycle, its role in supporting waste recycling, and its enhancement of soil fertility are important aspects. (Hwangbo, 2009; Zhang et al., 2012)

The protein-rich nutritional content of *M. domestica* larvae often leads to their use as animal feed. With their high protein content and rapid development capabilities, these larvae serve as an effective and economical food source for poultry, fish, and other animals. The use of these larvae in animal feed also plays a significant role in food safety and sustainable agriculture. (Hwangbo, 2009; Zhang et al., 2012)

Improving the growth performance of *Musca domestica* offers significant economic and environmental benefits. Faster and more efficient larval growth results in higher biomass production and, consequently, a greater protein source. Additionally, this performance enhancement allows for more effective production processes at both laboratory and industrial scales. Researchers are exploring the use of natural additives like propolisto bolster this performance enhancement and improve the health of larvae.

Natural additives can promote sustainable production by reducing environmental impacts and improving the overall developmental quality of the larvae. This supports the more effective use of *M. domestica* in animal feed production. (Kovtunova et al., 2018; Geden et al., 2021; Ganda et al., 2022)

The aim of this research is to determine the effects of propolis on the developmental stages of *M. domestica* and the biochemical components (protein, carbohydrate, lipid) in larvae. The study seeks to investigate how different doses of propolis affect the developmental duration, weight, and size of *M. domestica* larvae. Additionally, the research aims to evaluate the impact of propolis on the biochemical components of the larvae to understand their role in development and health. The potential of propolis to enhance the growth performance of *Musca domestica* larvae and its effects on efficiency will also be explored. The findings of the research will reveal the effects of propolis on *Musca domestica* and contribute to the applications of this knowledge in ecological studies.

MATERIAL AND METHOD

Examination of the Developmental Cycle

This study was conducted between and February June 2024 at the Animal Physiology Laboratory of, Ondokuz Mayıs University, Samsun. This study was designed to investigate the effects of different propolis concentrations on the larval and adult traits of *M. domestica*.

Establishment of Musca domestica Colony: Adult houseflies were captured from a dairy farm on the campus of the Ondokuz Mayıs University, Samsun, using aerial insect nets, between May and September 2019, and transported to the laboratory. The flies were maintained in cages (50x40x50 cm) at 62% relative humidity (RH), 25.6 ± 0.8 °C and a photoperiod of 12:12 (L:D) h light cycle (modified from Kökdener, 2021).

Males and females were held together in the same cages. Sugar cubes and water were supplied ad libitum (Hogsette and Farkas 2002). In our experiments, we

utulized flies from the same generation of the colony in all replicates to minimize the genetic variability among the samples. Five days after adult emergence, a plastic cup containing a wheat bran diet was placed in the adult cage supplied as an oviposition substrate for 24 hours. Larvae that hatched from the eggs were transferred to glass jars containing with the wheat bran diet and reared them. Larvae were reared on wheat bran diet in glass jars covered with tulle, tightly held by rubber bands, following the previously described

Experimental Design: Propolis was dissolved in 1 ml of 70% ethanol to create a 1 g/ml propolis stock solution. From the prepared solution, different volumes (40 µl, 80 µl, 120 µl, and 160 µl) were taken and mixed with 30 g of wheat bran to prepare food containing four concentration of propolis. The diet were prepared by mixing the wheat bran and milk (wt/wt) to achieve moisture levels of 60% in the substrate. Cow milk was supplied from the market. Then the diets was prepared by mixing different concentration of propolis and placed in a 400 ml polypropylene clear plastic cups. Only 30 first-instar maggots were added to each of the treated and control diets. The wheat bran diet, without propolis (untreated), served as the control treatment. The tulle cover over the neck of the jar was secured with a rubber band to prevent the larvae from escaping the rearing jar. Five replicate jars were set up for each experimental treatment. A total of 25 tests (20 for different concentrations of propolis, and control) with 750 larvae total were performed larvae of *M. domestica* were used.

Effects of Different Doses of Propolis on the Developmental Cycle of M. domestica: The parameters measured were larval length, number of adults and pupae adult, pupal, and larval weight, and development time. Two larvae were sampled from each cup were recorded at regular intervals of 12 h. Larval weights were measured using a microbalance and larval lengths were measured using a ruler. The duration of each stage was decided by observing the larval stage duration from the first between the and observation of a stadium to the last observation. Larval counts were recorded daily until pupariation and dead larvae were removed. Larval development time was calculated as the duration of the development from the first instar (i.e., egg hatching) until pupariation and the duration of each stage was the time between the first and last observations of the particular stage. Pupariae were monitored every 12 hr until adult emergence. Pupariae and adult weights were recorded. Pupal development time was calculated as the duration of development from the time of pupation to the emergence of the adult. Gender of the surviving adults was recorded for each treatments.

Statistical Analysis: All analyses were used IBM SPSS Statistics 20 software programme. Normality analyses was determined by the Shapiro–Wilk test. Aone way ANOVA was used to analyze the data on the percentage of pupal and larval, development time, pupal and larval survival. In the event of a significant F-test ($P<0.05$), the Tukey's HSD test was used to compare means.

Analysis of Protein, Carbohydrate, and Lipid Levels

Preparation of Diets Containing Different Concentrations of Propolis for Biochemical Analysis and Acquisition of Larvae: In our study, to determine how propolis in different amounts affects the consumption amounts, larval weights, larval protein lipid and carbohydrate amounts, and development time of *Musca domestica* larvae. This study used propolis at four concentrations (explained above). Different concentrations of propolis solutions (40 µl, 80 µl, 120 µl, and 160 µl/g) homogenized the wheat bran diets. We mixed a wheat bran diet with milk as the control treatment

Two diets were prepared for each propolis concentration. Jars were maintained at same the laboratory conditions and monitored every 12 h until the third instar. When the larvae reached the third instar, 15 larvae were collected from the diets for protein analysis, and 15 larvae were collected for carbohydrate and lipid analyses. The larvae were numbered and stored at -20°C until the analysis were conducted.

Protein Analysis: Protein contents were determined through the Yılmaz and Akman Gündüz (2021) method. Larvae were homogenized in K2HPO4 (500 µl).

The homogenate was then diluted with the buffer solution (1000 µl) and centrifuged at 3500 rpm and +4°C for 15 minutes. After centrifugation, this supernatant, was diluted with 900 µl buffer. 100 µl of the solution was added 2500 µl of Solution A (CuSO4) and 900 µl of water. This mixture was left to stand for 10 minutes. Subsequently, 250 µl of Solution B (Folin-Ciocalteu) was added, and the mixture was left to stand for 45 minutes. The prepared mixture was then vortexed, and the absorbance was read at 695 nm against a blank (the blank was 1000 µl of distilled water).

Carbohydrate and Lipid Analysis: Carbohydrate and lipid contents were determined through the Yılmaz and Akman Gündüz (2021). The larvae were homogenized the larvae were homogenized (100 µl) then 900 µl of the chloroform-methanol (1:2) mixture was added and mixed. The mixture was then centrifuged at 14,000 rpm for 2 minutes. After centrifugation, 100 µl of the supernatant was taken and transferred to a new tube, and 900 µl of the chloroform-methanol (1:2) mixture was added. Then 100 µl of solution was used for carbohydrate and lipid analysis. For carbohydrate analysis, 100 µl of the sample is reduced to approximately 50 µl in a 90 °C water bath. Afterward,

950 µl of anthrone reagent was added and placed back into the water bath at 90 ºC for 15 minutes. After cooling on ice, we measured the absorbance at 695 nm in comparison to a blank.

For lipid analysis, 100 µl of the solution was heated in a water bath at 90 ºC until it completely evaporated. 40 µl of concentrated sulfuric acid was added, and then incubated in the water bath at 90 ºC for 2 minutes. The solutions were removed from the water bath, cooled on ice, and 960 µl of vanillin-phosphoric acid reagent was added. These suspensions were left at room temperature for 30 minutes. The absorbance of the sample was read at 525 nm wavelength.

***Statistical Analysis**:* The effect of propolis on the protein, carbohydrate, and lipid content of *M. domestica* larvae was evaluated using one-way analysis of variance (ANOVA). All statistical data analyses were carried out with the software package SPSS (version 21). The significance between control and treatments group was compared using the Student-Newman-Keuls (SNK) test at a 5% level.

RESULTS

Larval and Pupal Development Duration: Mean larval and pupal development times are shown in Table 1. Larval development time was not significantly different among concentrations (F=0.670; p<0.616). Pupal development time differed significantly among concentrations (F=21785.439; p<0.000) (Table 1).

While the larval development time was similar at four concentrations of propolis. The pupal development time taken to complete the development of the control group is longer than the treated group.

Table 1. Larval and pupal development time of *musca domestica* on diets containing propolis.

Concentration	Larval Duration (days) (Mean±SD)	Pupal Duration (days) (Mean±SD)
1	4.00±0.005a	5.61±0.003a
2	4.44±0.002a	5.05±0.005a
3	4.37±0,003a	4.54±0.003b
4	4.21±0.004a	4.09±0.003b
Control	4.81±0.009a	5.73±0.004a
	P<0.616	**P<0.000**

Concentration 1 (40 µl/30g), concentration 2 (80 µl/30g), concentration 3 (120 µl/30g), concentration 4 (160 µl/30g). Means within the same column followed by different letters are significantly different according to the Tukey test at a 5% significance level (P<0.05).

Larval Length and Weight: The mean larval weights and lengths sampled from different concentrations of the propolis are shown in Table 2. The mean larval weights and lengths significantly differed among treatments on days 1 (Larval Length: F=2.640; P<0.046, Larval Weight: F=3.118; P<0.024) and 2 (Larval Length: F=10.269; P<0.000, Larval Weight: F=13.598; P<0.000). Propolis affected larval growth in length and weight in a dose dependent manner on day 1 and 2.

Larval length and weight were not significantly different among treatments on day 3 (Larval Length: F=1.337; P<0.271, Larval Weight: F=0.580; P<0.724) and 4 (Larval Length: F=2.397; P<0.064, Larval Weight: F=1.638; P<0.181).

Table 2. Mean larval length and larval weight of musca domestica exposed to different propolis concentrations at different days of experimental set up

Concentratior	Larval Length (mm)/ Larval Weight (g)	Day 1 (Mean±SD)	Day 2 (Mean±SD)	Day 3 (Mean±SD)	Day 4 (Mean±SD)
1	LL	4.62±0.35ab	9.97±0.55bc	11.82±0.30a	12.56±0.18ab
	LW	0.0017±0.0004ab	0.0135±0.0015b	0.0230±0.0006a	0.0267±0.0006a
2	LL	4.32±0.35ab	9.63±0.24b	11.79±0.46a	12.50±0.17ab
	LW	0.0016±0.0002ab	0.0090±0.0013ab	0.0222±0.0009a	0.0251±0.0010a
3	LL	4.31±0.25ab	8.56±0.51ab	11.62±0.22a	12.35±0.12ab
	LW	0.0013±0.0002ab	0.0089±0.0012ab	0.0214±0.0020a	0.0250±0.0005a
4	LL	4.09±0.38a	7.60±0.67a	11.53±0.17a	12.20±0.18a
	LW	0.0009±0.0001a	0.0075±0.0014a	0.0207±0.0017a	0.0249±0.0011a
Control	LL	5,37±0,21b	11,62±0,214c	12,40±0,22a	13,01±0,30b
		P<0,046	**P<0,000**	**P<0,271**	**P<0,064**
	LW	0,0020±0,0005b	0,0195±0,0038c	0,0236±0,0007a	0,0228±0,0017a
		P<0,024	**P<0,000**	**P<0,580**	**P<0,181**

Concentration 1 (40 µl/30g), concentration 2 (80 µl/30g), concentration 3 (120 µl/30g), concentration 4 (160 µl/30g Means within the same column followed by different letters are significantly different according to the Tukey test at 5% significance level (P<0.05).

Pupal and Adult Weights: The mean pupal and adult weights are shown in Table 3. Mean pupal weight differed significantly among treatments (F: 11.384; P<0.000). The mean pupal weight generally increased with increasing propolis concentration. Female weight was significantly different among treatments (F: 29.485; P<0.000). Female weight increased with increasing propolis concentration. However, male weight was not significantly different among treatments (F: 0.359; P<0.837)

Table 3. Pupal and adult weights at different propolis concentrations.

Concentration	Pupal Weight (g) (Mean±SD)	Female Weight (g) (Mean±SD)	Male Weight (g) (Mean±SD)
1	0.0192±0.0003ab	0.0029±0.00007a	0.0029±0.00007b
2	0.0194±0.0004b	0.0028±0.00007a	0.0030±0.00006b
3	0.0195±0.0003b	0.0028±0.00005a	0.0032±0.00006bc
4	0.0214±0.0006c	0.0028±0.00006a	0.0033±0.00006c
Control	0.0178±0.0003a	0.0029±0.00007a	0.0024±.00007a
	P<0.000	**P<0.837**	**P<0.000**

Concentration 1 (40 µl/30g), concentration 2 (80 µl/30g), concentration 3 (120 µl/30g), concentration 4 (160 µl/30g). Means within the same column followed by different letters are significantly different according to the Tukey test at a 5% significance level (P<0.05).

***Number of Pupae and Adults**:* The mean number of pupae and adults are shown in Table 4. The number of pupae differed significantly among treatments (F: 12.457; P<0.000). Number of males differed significantly among treatments (F: 2.877, P<0.049); however, the number of females was not significantly different among treatments (F: 2.752; P<0.057). The mortality rate of pupae and adults increased with increasing propolis concentrations.

Table 4. Number of Pupae and Adults at Different Propolis Concentrations.

Concentration	Number of Pupae (Mean±SD)	Number of Females (Mean±SD)	Number of Males (Mean±SD)
1	15.80±0.73bc	5.60±0.87ab	6.80±0.92ab
2	13.60±0.68bc	5.20±0.73ab	6.60±0.81ab
3	13.20±0.86b	4.40±0.40ab	5.80±0.37ab
4	10.20±0.37a	3.60±0.40a	4.80±0.49a
Control	16.20±0.66c	6.60±0.81b	8.00±0.83b
	P<0.000	**P<0.049**	**P<0.057**

Concentration 1 (40 µl/30g), concentration 2 (80 µl/30g), concentration 3 (120 µl/30g), concentration 4 (160 µl/30g). Means within the same column followed by different letters are significantly different according to the Tukey test at a 5% significance level (P<0.05).

Protein Amount: The protein amount of *M. domestica* larvae is shown in Figure 1. Larvae reared on a diet with different concentrations of propolis also had a lower content of protein when compared to the control. The protein content was not significantly different among concentrations (F = 1.701, P = 0.160).

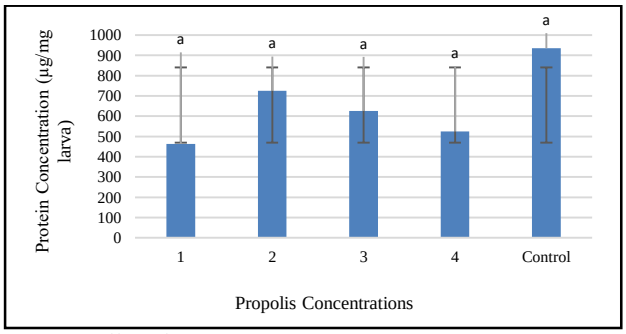

Figure 1. Effect of Propolis on Protein Amount in M. domestica Larvae. Concentration 1 (40 µl/30g), concentration 2 (80 µl/30g), concentration 3 (120 µl/30g), concentration 4 (160 µl/30g).

Carbohydrate Amount: The carbohydrate amount of *M. domestica* larvae is shown in Figure 2. The carbohydrate amount of *M. domestica* was significantly different among concentrations (F = 4.894, P = 0.002). The carbohydrate amount was similar at concentrations 1 and 2.

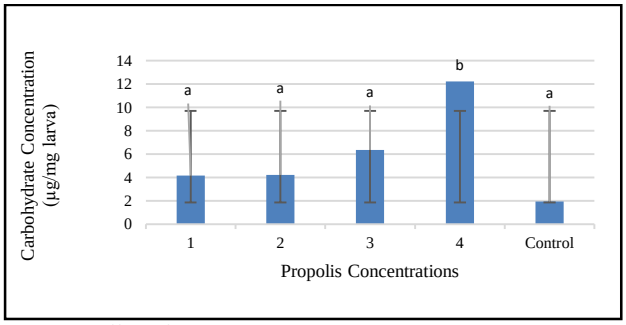

Figure 2. Effect of Propolis on Carbonhydrate Amount in M. domestica Larvae. Concentration 1 (40 µl/30g), concentration 2 (80 µl/30g), concentration 3 (120 µl/30g), concentration 4 (160 µl/30g).

Lipid Amount: The lipid amount of *M. domestica* larvae is shown in Figure 3. The lipid amount of *M. domestica* was significantly different among concentrations (F = 4.253, P = 0.004). The lipid amount was similar at concentrations 3 and 4.

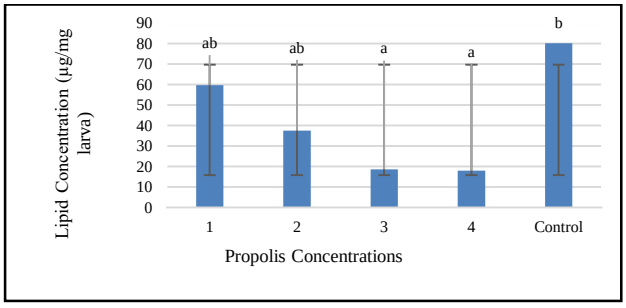

Figure 3. Effect of Propolis on Lipid Amount in *M. domestica* Larvae. Concentration 1 (40 µl/30g), concentration 2 (80 µl/30g), concentration 3 (120 µl/30g), concentration 4 (160 µl/30g).

DISCUSSION

Insects need sufficient protein, vitamins, lipids, carbohydrates and minerals in their diet in order to perform functions such as growth, development and reproduction. Diet is one of the important factors impacting the biochemical parameters of insects (Tognocchi et al., 2024). The present study was designed to determine how four different concentrations of propolis affect a number of life-history variables and biochemical composition of *M. domestica.*

In present study, mean larval weight in the control treatment was higher than for the rest of the treatments during three days. After 4 day, mean larval weight of concentrations 1 (0.0267 g) was higher than for the rest of the treatments. The lowest weight was recorded at control (0.0228) at 4 th days. Bakaaki et al., 2023, observed that the mean black soldier fly larvae (BSFL) weight in the propolis treatments was higher than that for the control for the first 5 and 10 days.

In the present study, the mean weight of larvae decreased with the increasing propolis concentration. Mean larval weight of the concentration 4 was lower than the concentrations 1 during four days. Seven et al., (2012) said that propolis is rich in compounds such as flavonoids and benzoic acid which enhance nutrient digestibility. These compounds have positively impacted feed intake which conduced to increased weight of housefly larvae treated with propolis. Contrary to our study, Bakaaki et al., 2023 showed that the 0.8g propolis (highest concentrations) treatment yielded the heaviest larvae (mean weight 0.183g) while the control treatment (0g propolis treatment) generated the least larvae weight (mean weight 0.17g) at the end of 10 days.

Kökdener and Kiper (2020) emphasized that a balanced diet provides better results and that the developmental performance of house flies positively increases with the increase in diet quality. Hence the concentration 1 might have been the most ideal quality feedstock to enhance the larval weight of housefies.

In the present study, larval and pupal survival was affected by propolis exposure, and the larval and pupal mortality of *M. domestica* increased with increasing propolis concentrations in the diets. Larval nutrition influences the larval and pupal mortality (Kökdener and Kiper, 2020).

Similarly, Ararso and Legesse (2016) showed that high concentration of propolis, 8 and 10 % w/v were the most toxic causing 90% and 80% mortality of lesser wax moth. In contrast to our study, Bakaaki et al., 2023 indicated that the 0.6g propolis treatment produced the highest pupae number while the 0.2g propolis treatment produced the least pupae number during the first ten days.

The control gave the highest mean pupae and adult number, while the concentrations 4 gave the least mean pupae number. The number of pupae of concentrations 1 (15.80) was similar to control (16.20). Similarly, Kökdener and Kiper (2020) observed that the highest percentage of larval and pupal survival was recorded at the wheat bran diet. Garedew et al. 2003 showed that, propolis sensitivity differed according to larval stages. For example treatment with 4% propolis resulted in 100% mortality of larval stage 5 (L5) of *G. mellonella*.

In the present study the total larval development time taken to complete development of the control group (10.54 days) is longer than the treated group by approximately (0.93–2.24 days) The larval development period was similar at four concentrations of propolis and approximately 9-19 hr shorter than in the control. This may indicate propolis extract acelerated development stage.

The pupal development times decreased with increasing propolis concentrations in the diets 0.12-1.64 days when compared to the control. Our results are in line with Garedew et al. 2003 showed that the length of the pupal phase of *Galleria mellonella* (Lepidoptera: Pyralidae), decreased with increased concentration of propolis.

The control group's larval and pupal development duration are longer than the treated group in our study. Similary, Bakaaki et al., 2023 observed that all pupae from propolis treated substrate emerged into adult flies earlier (5 days) compared to other treatments. In the current study, propolis addition to wheat bran enhanced the growth performance of *M. domestica*. Our results are in line with Garedew et al. 2003 who found that propolis accelerates the development of the larval/pupal stage of *G. mellonella.* Similarly, Ararso and Legesse (2016) showed that earlier adult emergence of lesser wax moth was observed in treatments of higher concentrations. In present study, propolis have impacted the amount of lipids, proteins, and carbohydrates, which results in altering development times.

Propolis has an effect on the pupal weight in a dose-dependent manner in our study. The results from this study also showed that an increase in the concentration of the propolis affects the adults (male) and pupal weight. Chemicals, larval density, tissue type, and diet significantly impacted pupal weight and hence the resulting adult dry mass.

In the present study, dietary propolis supplementation resulted in alterations in the amount of biochemical parameters among treatments. Overall, the results indicated that propolis was not significantly affecting the protein levels in the larvae. The stability of protein levels suggests that propolis does not have a notable impact on protein metabolism.

CONCLUSION

To the best of our knowledge, first studies have examined the effects of propolis on the development of *M. domestica*. The data indicated that the increased concentrations of propolis significantly affect some life history traits of *M. domestica*. Total development was a faster time in the presence of propolis as compared to control. Larval weights decreased with increasing propolis concentrations, but pupal weights increased. Our results showed that increasing propolis concentrations have an adverse effect on insects' larval and pupal survival. High dose propolis has negative effects on some parameters of *M. domestica* larvae. In addition, propolis reduced the total protein and amount, increase carbonhydrate amount.

Further study would be indicated to investigate how the specific components of propolis affect the performance of fies and the effect of propolis on the life characteristics of the adult housefly. Comprehensive studies should be conducted on the effects of propolis on different insect species. Specifically, extensive studies could be conducted to understand the impact of propolis on different insect species.

Conflict of Interest: The authors declare that there are no conflicts of interest.

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