

The effect of partial replacement of mealworm larvae (*Tenebrio Molitor*) by soybean meal in diet on biochemical characters of blood for broiler Ross 308

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Abstract

This study was conducted in poultry farm in the department of Animal production, Faculty of Agricultural, University of Kufa, from 28 October till 3 December for 35 days. A 225 of broiler chicks were used from one day old with initial weight 41g, to study the effect of replacement of mealworm larvae (*Tenebrio Molitor*) by soybean meal in diet on biochemical characters of blood for broiler Ross 308. The chicks were randomly distributed for five treatments, 45 chicks for each with three replicates, 15 chicks/ rep. and the treatments were as follow: : T1 control with basal diet free of any addition, T2 Replacing 4% of mealworm (*Tenebrio Molitor*) larvae instead of soybean meal, T3 Replacing 8% of mealworm (*Tenebrio Molitor*) larvae instead of soybean meal, T4 Replacing 12% of mealworm (*Tenebrio Molitor*) larvae instead of soybean meal, T5 Replacing 16% of mealworm (*Tenebrio Molitor*) larvae instead of soybean meal. The results were as follows: No significant differences in total protein, Albumen and globulin in all experimental treatments as compared with control. A significant ($P \leq 0.05$) decreases in cholesterol concentration and triglycerides in all experimental treatments as compare with control.

Keywords: mealworm, soybean meal, broiler, blood biochemical characters, partial replacement.

Introduction

Global population is expected to increase more than third of the current population to reach nine billion by 2050. This increase is accompanied by increasing demand for nutrients used in human diet, particularly seeds and protein sources. Consequently, a huge growth in the market of animal feed will occur by 2050[6]. Preparation of chicken feed that contains all essential nutrients required for fast growth is one of the main challenges in chicken production industry. Soybean has been used as a protein source in chicken feed [12]. Currently, many new animal production systems are looking for new sustainable protein sources that is able to meet the increasing demand and reduce their dependence on classical protein sources. In

this context, insects have emerged as a candidate replacement for protein sources. It contains 40-60% protein and 30-40% fats in their dry weight. Moreover, the chemical structure of both essential amino acids and fatty acids of the insects is similar to those found in a soybean which makes them a suitable choice to be used in chicken feed [9]. *Tenebrio Molitor* has emerged among many other insects as a replacement for protein source in chicken feed [7]. Many studies have revealed that a significant improvement in the biochemical characteristics of broilers have occurred when *Tenebrio Molitor* was used in the broiler's feed. A significant increase in serum total protein and albumin levels has also been reported, which reflects an improvement in broiler's health and immunological status [2;4;5;13].

This study was aimed at evaluating the effect of partial replacement of soybean by *Tenebrio Molitor* dry powder in the **Material and Methods**

Prepare the experiment:

This experiment was conducted at poultry farm in department of Animal production, Faculty of Agricultural, University of Kufa, from 28 October till 3 December for 35 days.

Studied traits:

Experimental treatments

A 225 of broiler chicks were used from one day old with initial weight 41g, were collected from local hatchery to study the effect of replacement of mealworm larvae (*Tenebrio Molitor*) by soybean meal in diet on biochemical characters of blood for broiler Ross 308. The chicks were randomly distributed for five treatments, 45 chicks for each with three replicates, 15 chicks/ rep. and the treatments were as follow:

T1: control with basil diet free of any addition.

T2: Replacing 4% of mealworm (*Tenebrio Molitor*) larvae instead of soybean meal.

T3: Replacing 8% of mealworm (*Tenebrio Molitor*) larvae instead of soybean meal.

T4: Replacing 12% of mealworm (*Tenebrio Molitor*) larvae instead of soybean meal.

T5: Replacing 16% of mealworm (*Tenebrio Molitor*) larvae instead of soybean meal.

A randomly blood samples (Male) were collected from each replicates for all

broiler Rose 308 feed on the broiler's biochemical characteristics.

experiments at the end of the experimental period (marketing Age) by collecting blood from venous vein according to health and welfare protocol by using sterilized test tubes (without heparin) were saved sloping to separate serum, until carry them to the lab. to test the biochemical characters of blood: total protein, Albumen, globulin, cholesterol concentration and fatty acids. The chicks were fed two diets: starter diet from 1 to 21 days of age which content 22.3 of crude protein and 2950 kilo calorie of metabolism energy / Kg, Finisher diet from 22 to 35 days of age which content 21 of crude protein and 3050 kilo calories of metabolism energy / Kg (Table1). The chicks were Ad libitum feeding. The data were analyses by using completely randomize design to know the differences between treatments by using Duncan test (1955) at level 0.05 % by using SAS program (2021) according to the equation:

$$Y_{ij} = \mu + t_i + e_{ij}$$

Results and Discussion

Shoot length (cm)

Table 2 shows the effect of partial replacement of Mealworm (*Tenebrio Molitor*) larvae instead of soybean meal in the diet on some biochemical characters of broiler blood. The statically analysis result shows that there are no significant differences between all experimental treatments in total protein, Albumen and Globulin in blood serum as compared to control treatment. A significant difference ($P \leq 0.05$) between some experimental

Table 1. Composition of Diets

Finisher Diets					Starter Diets					Ingredient's ratio
T5	T4	T3	T2	T1	T5	T4	T3	T2	T1	
63.6	63.6	63.6	63.6	63.6	60.4	60.4	60.4	60.4	60.4	Yellow corn
27.72	29.04	30.36	31.68	33	30.24	31.68	33.12	34.56	36	Soybean Meal
5.28	3.96	2.32	1.32	0	5.76	4.32	2.88	1.44	0	Mealworm larvae ¹
2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	Premix ²
0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	Di. calcium phosphate
0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	Limestone
100	100	100	100	100	100	100	100	100	100	Total %
Chemical analysis										
3217	3217	3213	3208	3200	2972	2969	2963	2958	2950	Kcal/kg
18.1	18.1	18	18	18	22.5	22.4	22.3	22.3	22.3	Crude protein
0.54	0.52	0.52	0.51	0.51	0.58	0.57	0.56	0.56	0.56	Methionine
1.25	1.24	1.24	1.23	1.23	1.51	1.50	1.50	1.49	1.49	Lysine
2.85	2.8	2.75	2.7	2.7	2.73	2.69	2.65	2.6	2.5	Crude Fat (E.E)
¹ Mealworm larvae(g): Isoleucine 2.92, Leucine 3.45, Valine 0.83, Lysine 2.97, Methionine 1.80, Tyrosine 3.28, Arginine 4.27, Glycine 3.17 ² Premix: Premix contained: Protein 45%, 2200 Kcal/kg Met.En., Fiber 3%, Fat 8%, Phosphorus (av) 0.12%, calcium 6%, meth. 2%, Lys. 3%, Cys.+ meth. 2.5%. E 500 mg, A 30.000 IU, K 40 mg, D3 30.000 IU, B1 30 mg, B6 60 mg, B2 75mg, Folic acid 15 mg, Pantothenic acid 120 mg, Niacin 400 mg, choline 1.7%, biotin 1500 mg, Cu 70%, Na 1.5 %, Fe 450 mg, Zn 600 mg, potassium iodine 5 mg, Se 1 mg and cob 1 mg.										

treatments in cholesterol concentration as compared to control treatment which record 123.14 mg/100ml and T5 which record 86.61mg/ml, while no significant differences between other experimental treatments as compared to control like T2, T3, and T4 which record 103.59, 104.6 and 95.89 respectively. Also, from table 2 there is a significant supreme ($P \leq 0.05$) for control treatment which record 83.86 mg/100ml as compare with experimental treatments T2, T3, T4 and T5 which record

73.2, 75.2, 66.167 and 62.133 mg/ml respectively, while T2 and T3 record significant supreme ($P \leq 0.05$) as compare with T4 and T5, in the other side no significant differences between T2 and T3 or between T4 and T5. The decreases of cholesterol concentration and triglycerides in blood serum may as cause chitin in Mealworm (*Tenebrio Molitor*) larvae which has the ability to bind cholesterol and bile inside the digestive tract which causes it to excrete it with the waste as an

Table 2. The effect of partial replacement of Mealworm (*Tenebrio Molitor*) larvae instead of soybean meal in the diet on some biochemical characters of blood of broiler Ross 308 (mg/100ml)

Treatments	Total protein	Albumen	Globulin	Cholesterol	Triglycerides
T1 control	2.836 ± 0.123	1.473 ± 0.075	1.360 ± 0.186	123.13 ± 8.390 ^a	83.86 ± 0.961 ^a
T2	3.060 ± 0.085	1.670 ± 0.096	1.386 ± 0.144	103.59 ± 0.928 ^{ab}	73.20 ± 2.809 ^b
T3	2.926 ± 0.226	1.576 ± 0.086	1.350 ± 0.276	104.76 ± 4.540 ^{ab}	75.20 ± 1.222 ^b
T4	2.753 ± 0.081	1.673 ± 0.078	1.080 ± 0.085	95.89 ± 12.785 ^{ab}	66.167 ± 2.324 ^c
T5	2.986 ± 0.143	1.656 ± 0.092	1.330 ± 0.056	86.61 ± 8.852 ^b	62.133 ± 1.139 ^c
Sig. levels	N.S	N.S	N.S	*	*

* $P \leq 0.05$: the same letters in the columns mean they were not significantly different.

NS: No significant differences.

T1, T2, T3, T4 and T5 addition of *Tenebrio Molitor* larvae (TML) 0, 4, 8, 12 and 16 g of diets respectively.

indicator of low serum concentration of cholesterol. The polysaccharides in Mealworm (*Tenebrio Molitor*) larvae regulate the fatty acids metabolism by binding fatty acids with bile this cause

Conclusion

According to obtained results the partial replacement of soybean by *Tenebrio Molitor* dry powder in the broiler diet had no bad effect on broiler's Rose 308 biochemical characteristics.

with either cultivar was superior treatment with most of parameters compared to the control of both cultivars.

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References

[1] Biasato, I., L. Gasco, M. De Marco, M. Renna, L. Rotolo, S. Dabbou, M. T. Capucchio, E. Biasibetti, M. Tarantola, L.

cholesterol and triglycerides decrease in blood serum [2;4;5;13].

Sterpone, L. Cavallarin, F. Gai, L. Pozzo, S. Bergagna, D. Dezzutto, I. Zoccarato, and A. Schiavone. 2018. Yellow mealworm larvae (*Tenebrio Molitor*) inclusion in diets for male broiler chickens: effects on growth performance, gut morphology, and histological findings. Poultry Science Association Inc. 540-548.

[2] Chen, L., He, X., Pu, Y., Cao, J., & Jiang, W. (2023). Polysaccharide-based biosorbents for cholesterol and bile salts in gastric-intestinal passage: Advances and future trends. Comprehensive Reviews in Food Science and Food Safety, 22(5), 3790–3813

[3] Dicke, M. 2018. Insects as feed and the sustainable development goals. J Insects Food Feed. 4(3):147-56.

- [4] Elahi, U., J. Wang, Y. Ma, S.Wu, J. Wu, G. Qi, and H. Zhang.2020. Evaluation of Yellow Mealworm Meal as a Protein Feed stuff in the Diet of Broiler Chicks. doi:10.3390/ani10020224
- [5] Elahi, U., Xu, C. C., Wang, J., Lin, J., Wu, S. G., Zhang, H. J.,&Qi, G. H. (2022). Insect meal as a feed ingredient for poultry. *Animal Bioscience*, 35(2), 332–346.
- [6] **FAO (Food and Agriculture Organization of the United Nations), 2013.** Edible insects – future prospects for food and feed security. *FAO Forestry Paper* 171, IX.
- [7] **Hamza, Sabah Hussin (2020).** Evaluation of completely replacement of Mealworm (*Tenebrio Molitor*) larvae by commercial protein concentration in broiler diet and its effect on productive, physiology and microbial performance of broiler. Master thesis, Faculty of Agriculture Engineering science , University of Baghdad.
- [8] **Majeed, Hadil Nafal(2025).** The effect of adding different levels of Yellow Mealworm (*Tenebrio Molitor*) larvae in diet on productive and physiology performance of broiler Ross 308. Master thesis, faculty of Agriculture, University of Dyala, Iraq.
- [9] **Makkar, H. P., Tran, G., Heuzé, V.,&Ankers, P. (2014).** State of the art on use of insects as animal feed. *Animal Feed Science and Technology*, 197, 1–33.
- [10] **Nassar, F.S, Alsahlawi, A.M, Al-Mahaish, M.A, Abbas, A.O, Alaqil, A.A,&Kamel, NN (2023).** Effect of dietary mealworm meal inclusion as a replacement for soybean meal on growth, physiological, and economic efficiency of broiler chickens. *Advances in Animal and Veterinary Sciences*, 11 (2), 310-319.
- [11] **NRC (National Research Council). 1994.** Nutrient requirements of poultry 9th rev. ed. National Academy Press, Washington, DC, USA.
- [12] **Van Huis, A., & Oonincx, D. G. (2017).** The environmental sustainability of insects as food and feed. Areview. *Agronomy for Sustainable Development*, 37(5), 1–4.
- [13] **Zhang, Y., (2024).** Biopolymer-based sequestrants for lowering cholesterol: Structures, in vitro bile acid binding effects, and interaction mechanisms. *Journal of Functional Foods*, 113, 106002