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Enhancing broiler chicken growth: The impact of dietary black soldier fly larvae [*Hermetia illucens*] on weight gain

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Abstract
This study investigated the effect of dietary Black Soldier Fly Larvae (*Hermetia illucens*) on the growth performance of broiler chickens at Dr. Sharadchandra Pawar College of Agriculture, Baramati from January to February 2024. A total of 160, day-old Vancobb 430Y broilers were randomly assigned to four treatment groups for 42 days: T_0 (basal diet), T_1 (96% basal diet + 4% insect meal), T_2 (94% basal diet + 6% insect meal), and T_3 (92% basal diet + 8% insect meal). Results showed that T_3 had the highest body weight (2652.08g) and weight gain (665.00g) at week six, indicating potential immunity benefits. These findings highlight the positive impact of Black Soldier Fly Larvae (*Hermetia illucens*) as a nutrient-dense alternative protein source for broiler diets.

Keywords: Black soldier fly larvae, broiler, chickens, growth performance, protein

1. Introduction
The increasing global population is driving a heightened demand for food, particularly animal protein, which strains livestock feed resources. This scenario underscores the urgent need to identify alternative protein sources for animal husbandry. Insects, as highlighted by Makkar *et al.*, (2014) [7], are emerging as viable options due to their nutritional advantages and low resource requirements. Recent regulatory changes by the European Commission now permit the use of insect proteins in aquafeeds, with plans to extend this to poultry feeds.
Among insects, the Black Soldier Fly (*Hermetia illucens*) stands out as a suitable replacement for conventional poultry feed ingredients, like soybean meal, due to its rich protein content and favorable amino acid profile. The larvae also have higher lipid levels, useful for biodiesel production, but their chitin content raises digestibility concerns for monogastric animals. Research on defatted Black Soldier Fly (*Hermetia illucens*) meal has yielded mixed results; for instance, Marono *et al.*, (2017) [8] observed potential drawbacks in feed intake and egg production in laying hens. Conversely, Cullere *et al.*, (2018) [1] reported comparable performance in growing quails fed diets incorporating 10-15% defatted Black Soldier Fly meal. Black Soldier Fly larvae (*Hermetia illucens*) can consume significant amounts of organic matter and thrive on diverse substrates, including decaying fruits and animal waste. The larvae's life cycle lasts about two months but can extend under limited feeding conditions. Adult flies, which do not feed, rely on energy reserves from their larval stage (Diclaro *et al.*, 2009) [6]. As interest in sustainable protein sources continues to rise, Black Soldier Fly presents a promising solution for the future of animal feed production.

2. Materials and methodology
The experiment was conducted at the poultry farm of Dr. Sharadchandra Pawar College of Agriculture in Baramati. A total of 160 day-old broiler chicks (Vancobb 430Y) were sourced from a local hatchery. Upon arrival, the chicks were weighed and then randomly assigned to one of four treatment groups, with each group comprising 40 chicks.
A standard basal diet was formulated using locally available feed ingredients, designed for three growth phases: pre-starter (0-10 days), starter (11-21 days), and finisher (22-42 days). The broilers were raised in a floor pen system for six weeks, during which feed and water were

provided ad libitum. Individual weights of the chicks were recorded at arrival and subsequently on a weekly basis.

In total, the study involved four treatments, with 160 birds distributed evenly across the treatments, resulting in 40 birds per group. The experiment was replicated four times and utilized a Completely Randomized Design (CRD). The treatment groups included a control group receiving only the basal diet, and three experimental groups receiving varying percentages of insect meal derived from Black Soldier Fly larvae (*Hermetia illucens*) mixed into the basal diet at 4%, 6%, and 8%, respectively.

3. Result and discussion

3.1 Body weight

The mean initial body weights (g) of day-old broiler chicks for treatments T_0, T_1, T_2, and T_3 were 40.75, 41.13, 41.00, and 40.83, respectively. At the end of the first week, the average cumulative body weights were 114.38 (T_0), 123.25 (T_1), 135.75 (T_2), and 154.33 (T_3), with T_3 showing the highest weight and being significantly different ($P \leq 0.01$) from the other treatments.

By the second week, cumulative body weights increased to 255.88 (T_0), 317.75 (T_1), 333.25 (T_2), and 371.08 (T_3), again with T_3 leading and significantly different from the others. In the third week, weights reached 536.13 (T_0), 612.75 (T_1), 706.25 (T_2), and 799.83 (T_3), maintaining T_3's superiority.

The fourth week saw weights of 964.88 (T_0), 1077.00 (T_1), 1215.50 (T_2), and 1342.58 (T_3), with T_3 still significantly ahead. By the fifth week, weights were 1499.88 (T_0), 1643.25 (T_1), 1819.50 (T_2), and 1987.08 (T_3). Finally, at six weeks, weights were 2076.13 (T_0), 2247.75 (T_1), 2443.25 (T_2), and 2652.08 (T_3), confirming T_3's significant advantage throughout. (see Table 1)

The analysis of growth performance in broiler chickens revealed that the highest body weight was achieved by the group fed an 8% inclusion of Black Soldier Fly larvae (*Hermetia illucens*) combined with a 92% basal diet (T_3), reaching a total weight of 2652.08 g. This group was closely followed by those receiving a 6% inclusion (T_2), with a body weight of 2443.25 g, and the 4% inclusion group (T_1), which reached 2247.75 g. The control group (T_0) recorded the lowest weight at 2076 g. These results highlight the positive impact of incorporating Black Soldier Fly larvae (*Hermetia illucens*) in broiler diets, suggesting that higher inclusion levels may enhance growth performance. However, it is crucial to recognize that the study focused only on 4%, 6%, and 8% inclusion levels, leaving the optimal level open for further research. (See Fig 1).

Significant differences in body weight gains were noted across all treatment groups from the first week until the end of the experiment. The T_3 group consistently demonstrated the highest mean body weight throughout the six-week period, attributable to increased feed consumption. Dabbou *et al.*, (2018) [5] similarly reported enhanced growth metrics in broilers fed diets containing Black Soldier Fly (*Hermetia illucens*) larvae, noting improved body weight and average daily gain during the starter phase. However, they cautioned that higher inclusion rates might negatively impact average daily gain in the finisher phase, potentially due to adverse effects on gut morphology.

3.2 Body weight gain

By the end of the first week, mean body weight gains were recorded at 73.63 g for T_0, 82.13 g for T_1, 94.75 g for T_2, and 113.50 g for T_3, with T_3 achieving the highest gain. This trend continued into the second week, with gains of 141.50 g for T_0, 194.50 g for T_1, 197.50 g for T_2, and 216.75 g for T_3. Analysis of variance confirmed statistically significant differences among the treatment groups, indicating a clear correlation between Black Soldier Fly larvae (*Hermetia illucens*) inclusion and growth performance.

In the third week, mean gains were 280.25 g for T_0, 295.00 g for T_1, 373.00 g for T_2, and 428.75 g for T_3, reinforcing the pattern of increased weight gains associated with higher inclusion levels. This trend persisted in the fourth week, where gains were 428.75 g for T_0, 464.25 g for T_1, 509.25 g for T_2, and 542.75 g for T_3. The fifth week showed gains of 535.00 g for T_0, 566.00 g for T_1, 604.00 g for T_2, and 644.50 g for T_3. By the end of the sixth week, results remained consistent, with mean body weight gains recorded at 576.25 g for T_0, 604.50 g for T_1, 623.75 g for T_2, and 665.00 g for T_3. In all cases, analysis confirmed the statistical significance of these differences. (see Table 2).

Additionally, research by Cutrignelli *et al.*, (2018) [4] indicated that feeding Black Soldier Fly larvae (*Hermetia illucens*) could enhance intestinal morphology, such as increased villi height in the duodenum. This suggests similar physiological improvements in broiler chickens, potentially contributing to enhanced weight gain. Overall, these findings underscore the benefits of integrating Black Soldier Fly larvae into poultry diets, especially in promoting growth and improving feed efficiency. Further studies are needed to determine optimal inclusion rates and their long-term impacts on growth performance and gut health in poultry. (See Fig 2).

Table 1: Effect of dietary addition of black soldier fly larvae (*Hermetia illucens*) on body weight (g) of broiler

Group	Age in weeks						
	Initial weight	1st week	2nd week	3rd week	4th week	5th week	6th week
T_0	40.75	114.38^{d}	255.88^{d}	536.13^{d}	964.88^{d}	1499.88^{d}	2076.13^{d}
T_1	41.13	123.25^{c}	317.75^{c}	612.75^{c}	1077.00^{c}	1643.25^{c}	2247.75^{c}
T_2	41.00	135.75^{b}	333.25^{b}	706.25^{b}	1215.50^{b}	1819.50^{b}	2443.25^{b}
T_3	40.83	154.33^{a}	371.08^{a}	799.83^{a}	1342.58^{a}	1987.08^{a}	2652.08^{a}
Overall Mean	40.93	139.43	319.49	663.74	1149.99	1737.43	2354.80
SEM	0.50	0.86	1.44	1.94	2.39	6.95	7.14
CD	NS	2.65	4.43	5.98	7.35	21.41	22.01

Different superscripts (a, b, c, d) within the same column show significant differences (p<0.05)

Table 2: Effect of dietary addition of black soldier fly larvae (*Hermetia illucens*) on body weight gain (g) of broiler

Group	Age in weeks					
	1st week	2nd week	3rd week	4th week	5th week	6th week
T_0	73.63^{d}	141.50^{d}	280.25^{d}	428.75^{d}	535.00^{d}	576.25^{d}
T_1	82.13^{c}	194.50^{c}	295.00^{c}	464.25^{c}	566.25^{c}	604.50^{c}
T_2	94.75^{b}	197.50^{b}	373.00^{b}	509.25^{b}	604.00^{b}	623.75^{b}
T_3	113.50^{a}	216.75^{a}	428.75^{a}	542.75^{a}	644.50^{a}	665.00^{a}
Overall Mean	91.00	187.56	344.25	486.25	587.44	617.38
SEM	0.69	0.95	1.08	1.11	1.39	1.60
CD	2.12	2.94	3.31	3.42	4.28	4.92

Different superscripts (a, b, c, d) within the same column show significant differences (p<0.05)

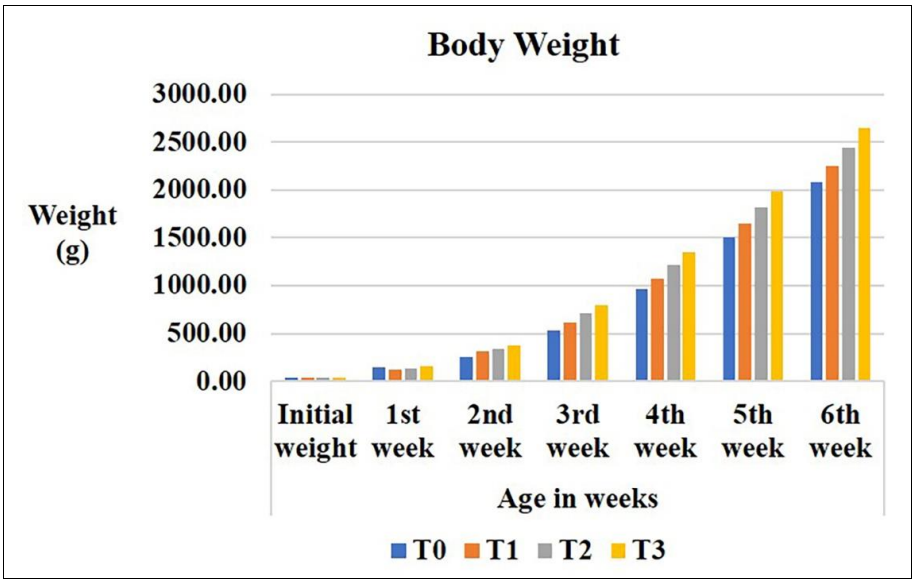

Fig 1: Weekly changes in the body weight of different group of broiler chicks

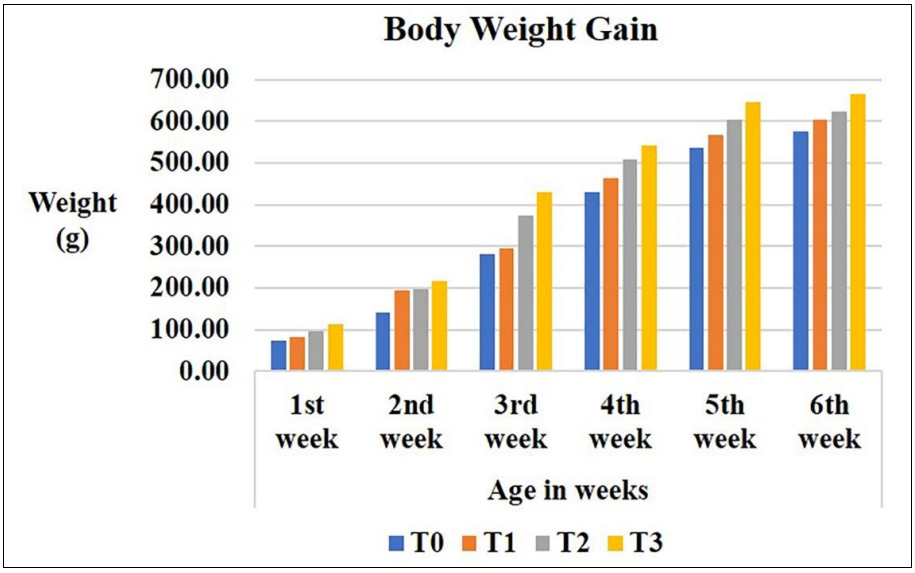

Fig 2: Weekly changes in the body weight gain of different group of broiler chicks

4. Conclusion

The results of the study clearly indicate that the inclusion of Black Soldier Fly larvae (*Hermetia illucens*) in broiler chicken diets significantly enhances growth performance, with the highest body weight observed in the group receiving an 8% inclusion. The consistent superiority of the T_3 treatment group throughout the experimental period underscores the potential benefits of integrating this insect-based protein source into poultry nutrition.

The progressive weight gains across all treatment groups highlight the positive correlation between the level of Black Soldier Fly larvae (*Hermetia illucens*) and overall growth metrics. The significant differences observed at each evaluation point suggest that higher inclusion rates not only promote weight gain but may also improve feed efficiency. Furthermore, the findings align with previous research by Dabbou *et al.*, (2018) [5], which similarly reported enhanced growth performance in broilers fed diets containing Black Soldier Fly larvae.

Moreover, the potential physiological benefits, such as improved gut morphology, as indicated by Cutrignelli *et al.*, (2018) [4], further support the inclusion of Black Soldier Fly larvae as a valuable dietary component. However, while the study suggests that an 8% inclusion level is effective, the question of optimal levels remains open for further investigation. Future research should explore higher inclusion rates and assess their long-term effects on growth performance, feed efficiency, and gut health in broiler chickens.

Incorporating Black Soldier Fly larvae into broiler diets appears to be a promising strategy for enhancing growth and feed efficiency, presenting an opportunity for sustainable poultry production. As the industry increasingly seeks alternative protein sources, further studies are warranted to optimize dietary formulations that can leverage the benefits of this innovative ingredient.

5. Acknowledgement

I would like to thank my parents for all the life lessons.

6. Conflict of Interest

Not available.

7. Financial Support

Not available.

8. References

1. Cullere M, Tasoniero G, Giaccone V, Acuti G, Marangon A, Dalle Zotte A, *et al*. Black soldier fly as dietary protein source for broiler quails: meat proximate composition, fatty acid and amino acid profile, oxidative status and sensory traits. Anim Int J Anim Biosci. 2018;12(3):640-607. DOI: 10.1017/S1751731117001860.
2. Cullere M, Tasoniero G, Giaccone V, Miotti-Scapin R, Claeys E, De Smet S, Dalle Zotte A. Black soldier fly as dietary protein source for broiler quails: apparent digestibility, excreta microbial load, feed choice, performance, carcass and meat traits. Anim Int J Anim Biosci. 2016;10(12):1923-1930. DOI: 10.1017/S1751731116001270.
3. Cullere M, Woods MJ, van Emmenes L, Pieterse E, Hoffman LC, Dalle Zotte A, *et al*. *Hermetia illucens* larvae reared on different substrates in broiler quail diets: Effect on physicochemical and sensory quality of the quail meat. Animals. 2019;9(8):525. DOI: 10.3390/ani9080525.
4. Cutrignelli MI, Messina M, Tulli F, Randazzo B, Olivotto I, Gasco L, *et al*. Evaluation of an insect meal of the Black Soldier Fly (*Hermetia illucens*) as soybean substitute: Intestinal morphometry, enzymatic and microbial activity in laying hens. Res Vet Sci. 2018;117:209-215.
5. Dabbou S, Gai F, Biasato I, Capucchio MT, Biasibetti E, Dezzutto D, *et al*. Black soldier fly defatted meal as a dietary protein source for broiler chickens: Effects on growth performance, blood traits, gut morphology and histological features. J Anim Sci Biotechnol., 2018, 9(1). DOI: 10.1186/s40104-018-0266-9.
6. Diclaro II, Kaufman JW. Black soldier fly *Hermetia illucens* Linnaeus (Insecta: Diptera: Stratiomyidae). EENY-461. Entomology and Nematology Department; c2009.
7. Makkar HPS, Tran G, Heuzé V, Ankers P. State-of-the-art on use of insects as animal feed. Anim Feed Sci Technol. 2014;197:31-33. DOI: 10.1016/j.anifeedsci.2014.07.008.
8. Marono S, Loponte R, Lombardi P, Vassalotti G, Pero ME, Russo F, Gasco L, Parisi G, Piccolo G, Nizza S, Di Meo C, Attia YA, *et al*. Productive performance and blood profiles of laying hens fed *Hermetia illucens* larvae meal as total replacement of soybean meal from 24 to 45 weeks of age. Poult Sci. 2017;96(6):1783-1790. DOI: 10.3382/ps/pew461.

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