A ROLE OF MEAL COMBINATION OF BLACK SOLDIER FLY AND CURCUMA ON ORGANIC CHICKEN PRODUCTION

Laurentius J.M. Rumokoy[1,2*], Yohannis R.L. Tulung[1], Wisje L. Toar[1]

[1]Department of Nutrition and Feed Sciences, Faculty of Animal Sciences, Sam Ratulangi University, Manado North Sulawesi, Indonezia
[2]Entomology Studies Program, Postgraduate School, Sam Ratulangi University, Manado North Sulawesi, Indonezia

Abstract

The role of Hermetia illucence or black-soldier-fly (BSF) is known not only to degrade waste material, but also as a source of nutrients for other animals. This article aims to present a part of our research works concerning the role of these insects in producing organic chickens. In this study we combined 1.5% H. illucens larvae (HIL) flour with 3.5% curcuma (Curcuma zanthorrhiza) flour mixed into the ration and supplied to native chickens aged 4 to 8 weeks. The animals were divided in two groups: 28 chickens were placed in a control group and 28 others were placed in a treatment group. The parameters were abdominal fat deposition and carcass weight. The mean value of comparisons of two groups was analyzed by paired t-test. The results showed that both of abdominal fat deposition and carcass weight of the chicken in treatment group was significantly higher than in control group (P <0.01). This condition could be linked to the content of organic molecules; especially to the essential amino acids found in the body of H. illucens larvae which supported the growth process of the animal's body that consumes these feed-additives. In addition, the curcuma bioactive substances play a role in the immune system, palatability of the ration that lead to improve the carcass weight.

Key words: black-soldier-fly; curcuma; broiler; body weight

INTRODUCTION

Promotions for consuming organic food are increasingly getting a positive response by consumers in various countries globally. This response shows an increase in consumption of organic food, especially from chicken products. Nevertheless there are still constraints of quality livestock feed ingredients that can guarantee these livestock products. Therefore, breakthroughs are needed simultaneously related to the production and availability of animal feed in line with the report of Tesseraud et al (2009) from local natural resources that aim to improve the organic livestock products themselves (Toar et al 2018; Rumokoy et al 2017).

The use of BSF insect flour could be applied as a solution in an organic farm because this insect flour contains important nutrient substances needed by poultry (Al-Qazzaz et al 2016). Besides that, Ali et al (2019) demonstrated that dipterose-BSF enhanced the expression of proinflammatory cytokines and interferon β (IFNβ) in RAW264.7 cells. Fouad and El-Senousey (2014) reported that nutritional factors could affect abdominal fat deposition in poultry. On the other hand, the development of native chicken is important to be developed by the farmers for rural economy development (Padhi, 2016). The farmers are already familiar with this kind of farm. In addition, native chickens do not require much capital compared to poultry farms. It was also noted that meat from native chickens had a better taste than purebred chicken products. This advantage could be understood because in traditional maintenance systems, native chickens are more proactive in looking for their own food such as various types of

*Corresponding author: rumokoy@msn.com
The manuscript was received: 27.07.2020
Accepted for publication: 04.04.2021

insects and local plants that grow naturally around them. In several countries it plays an important role for the development of the rural economy (Das et al 2008). The potential of curcuma in increasing palatability and metabolism function in chickens is the reason why we combine it with flour of BSF larvae to observe the increasing of abdominal fat and carcass weight improvement in this study period.

MATERIALS AND METHOD

As a part of our preliminary research the experiment was used 56 chickens aging from 5th to 8th weeks old. Animals were divided in two groups: G0 as a control group and G1 as a treatment group. In the treatment group animals were ad libitum supplied a complete ration with a combination of flour of HIL and CZR, consisted with 150 gr HIL * 100 kg-1 ration and CZR 350 gr * 100 kg-1 ration. During the experiment the chickens were reared by using pen designed with a battery system by a dimension 40*40*45cm. In this part of study the parameters measured were: abdominal fat weight and carcass weight. This measurement was realized at the end of the observation. Data were statistical analyzed by using t-test analysis according to Zar (2010).

RESULTS AND DISCUSSIONS

The data of carcass weight of the experimental chickens were presented in the figure bellow:

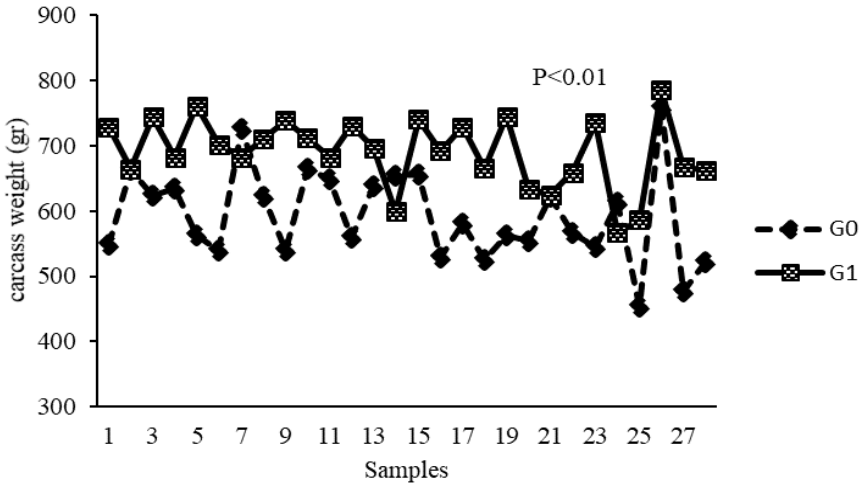

Fig. 1 The graph of carcass weight of the animals observed

The average of carcass weight of experimental chickens in the treatment group (G1) was 690 gr which was higher than in chickens of control group (G0) which was 592 gr. The statistical analysis by using t-test showed a significant difference in carcass weight of the two groups (P<0.01). This difference shows that a combination of HIL and CZR flour as a feed additive could improve the weight of organic chicken carcass. This performance related to the role of Black soldier fly (BSF) larvae in poultry feed as reported by several previous authors: Kawasaki et al (2019) mentioned as potential ingredient for poultry feed. Toar et al (2019) showed a positive effect of curcuma and BSF maggot meal combination on chicken weight. Schavone et al (2017) observed the nutritional value of BSF on broiler chickens: apparent nutrient digestibility, apparent metabolizable energy and apparent ileal amino acid digestibility. Oonincx et al (2015) suggested insects to efficiently convert feed to body mass.

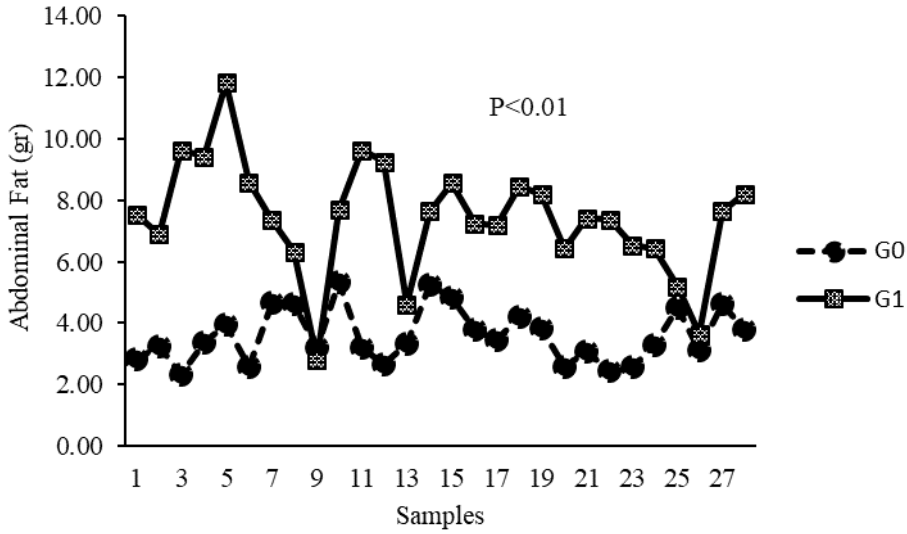

Fig. 2 The graph of abdominal deposition of the animals observed

The average of abdominal fat deposition of experimental chickens in the treatment group (G1) 7.42 gr which was higher than the chickens in control group (G0) which was 3.60 gr. The result of statistical analysis in this part showed a significant difference (P<0.01) of abdominal deposition between these two groups. This difference indicated that a combination of HIL and CZR flour as a feed additive favored the fat deposition in G1 compared to fat deposition G0. This fat accumulation activity was in line with metabolic activity in fat formation in adipose tissue of animal in G1. Toar et al (2019) reported the role of combination of curcuma and BSF larvae meal to the accumulative body weight of native chicken. The higher palatability, chicken consumption will also increase, which will have an impact on increasing feed energy consumption. Al-Qazzaz et al (2016) and Schiavone et al (2017) used BSF meals to improve the poultry production. The excess of energy consumed will be stored in fat form in adipose tissue which can be observed in an increase in abdominal fat weight. In this aspect of abdominal fat storage, animals in G0 have better performance than in G1. These results could be related to the scientific works using BSF protein and fat fraction reported by Cullere et al (2018).

CONCLUSIONS

Utilization of feed-additives derived from a combination of BSF larvae flour and curcuma flour can be supplied to chickens to increase productivity. On one side of this feed-additive increase carcass weight, but another effect is that when increasing consumption of chicken will have an impact on increasing abdominal fat weight.

RECOMMENDATION

To improve the organic poultry production, it is recommended to empower the local natural ressources like the insects especially *Hermetia illucens* (BSF). The BSF maggot and adult are important for poultry because of its nutrient content, beside that this species of insect is relatively easy to rear.

REFERENCES

[1] Ali, M.F.Z., Ohta, T. Ido, A. Miura, C. & Miura, T. (2019). The Dipterose of Black Soldier Fly *(Hermetia illucens)* Induces Innate Immune Response through Toll-Like Receptor Pathway in Mouse Macrophage RAW264.7 Cells. *Biomolecules*, 9(11): 677; https://doi.org/10.3390/biom9110677.

[2] Al-Qazzaz, M.F.A. Ismail, D. Akit, H. & Idris, L.H. (2016). Effect of using insect larvae meal as a complete protein source on quality and productivity characteristics of laying hens *R. Bras. Zootec*. 45 (9). http://dx.doi.org/10.1590/s1806-92902016000900003

[3] Cullere, M. Schiavone, A. Dabbou, S. Gasco, L. & Zotte, A.D. 2019. Meat Quality and Sensory Traits of Finisher Broiler Chickens Fed with Black Soldier Fly (*Hermetia Illucens* L.) Larvae Fat as Alternative Fat Source. *Animals (Basel).* 2019 Apr; 9(4): 140. doi: 10.3390/ani9040140.

[4] Das, S. C. Chowdhury, S. D. Khatun, M. A. Nishibori, M. Isobe, N. & Yoshimura, Y. 2008. Poultry production profile and expected future projection in Bangladesh. *World's Poultry Science Journal*, 64(1): 99–117. https://doi.org/10.1017/S0043933907001754

[5] Fouad, A.M. & El-Senousey, H.K. (2014). Nutritional Factors Affecting Abdominal Fat Deposition in Poultry: A Review. 27(7): 1057–1068. doi: 10.5713/ajas.2013.13702.

[6] Kawasaki, K. Hashimoto, Y. Hori, A. Kawasaki, T. Hirayasu, H. Iwase, S. Hashizume, A. Ido, A. Miura, C. Miura, T Nakamura, S. Seyama, T. Matsumoto, Y. Kasai, K & Fujitani, Y. 2019. Evaluation of Black Soldier Fly *(Hermetia illucens)* Larvae and Pre-Pupae Raised on Household Organic Waste, as Potential Ingredients for Poultry Feed. *Animals (Basel).* 9(3): 98. doi: 10.3390/ani9030098.

[7] Oonincx, D.G.A.B. van Broekhoven, Arnold, S. van Huis, & Joop J. A. van Loon. 2015. Feed Conversion, Survival and Development, and Composition of Four Insect Species on Diets Composed of Food By-Products. *PLoS One*. 2015; 10(12): e0144601. doi: 10.1371/journal.pone.0144601.

[8] Padhi, M.K. 2016. Review Article: Importance of Indigenous Breeds of Chicken for Rural Economy and Their Improvements for Higher Production Performance. *Scientifica* Vol 2016. http://dx.doi.org/10.1155/2016/2604685.

[9] Rumokoy, L. Adiani, S. Assa, G.J.V. Toar, W.L. Aban, J.L. 2017. Entomology contribution in animal immunity: Determination of the crude thoraxial glandular protein extract of *Stomoxys calcitrans* as an antibody production enhancer in young horses. *J. acarological research.* 49 (3):140-143. https://pagepressjournals.org/index.php/jear/article/view/7074.

[10] Schiavone, A. De Marco, M. Martínez, S. Dabbou, S. Renna, M. Madrid, J. Hernandez, F. Rotolo, L. Costa, P. Gai, F. Gasco, L. 2017. Nutritional value of a partially defatted and a highly defatted black soldier fly larvae (*Hermetia illucens* L.) meal for broiler chickens: apparent nutrient digestibility, apparent metabolizable energy and apparent ileal amino acid digestibility. *J Anim Sci Biotechnol*. 2017 Jun 1;8:51. doi: 10.1186/s40104-017-0181-5

[11] Tesseraud, S. Bouvarel, I. Collin, A. Audouin, E. Crochet, S. Seiliez, I. & Leterrier, C. 2009. Daily variations in dietary lysine content alter the expression of genes related to proteolysis in chicken pectoralis major muscle. *J Nutr*. 139:38–43. doi: 10.3945/jn.108.095752

[12] Toar, W.L. Tulung, M. Memah, V. Pudjihastuti, E. Rumokoy, L. & Untu, I.M. 2018 The presence of insect in animal farm in North Sulawesi *Scientific Papers: Series D, Animal Science* 61:220-224 http://animalsciencejournal.usamv.ro/pdf/2018/issue_1/Art39.pdf

[13] Toar, W.L. Rumokoy, L.J.M. Pudjihastuti, E. Manangkot, H. Bagau, B. & Untu, I.M. 2019. Effect of Supplementation of Combination of Curcuma and BSF Maggot Meal in Rations on Accumulative Weight of Native Chickens. *IOP Conference Series: Earth and Environmental Science*. https://iopscience.iop.org/article/10.1088/1755-1315/372/1/012009/pdf

[14] Zar, J.H. 2010. Biostatistical Analysis. 5th Edition. Prentice-Hall. New Jersey.