

bread waste as feed. BSFL successfully grew in all media with a waste degradation time that took as short as 14 days. BSFL has the highest biodegradation potential on a combination of TD up to 66.6% or a TD to the BW ratio of 2:1. Yielding with the highest biomass, survival rate (100%), WRR (87.16%), WRI (6.23), BCR (4.01%), RGR (8.89). The results of this study demonstrate that it is feasible for BSFL to use a combination of TD and BW as feeds. For future studies, the author recommends:

- Further compositional analysis of the feed to determine the composition of protein, carbohydrates, and fats.
- More research on the potential of the combination of TD and BW for the nutritional content of BSFL.
- Further understanding of the nutrient content of BSFL feed can provide further insight into larval growth performance
- Lastly, the present results support the possibility of biodegradation of local agricultural waste into a high value product (BSFL). Both tofu dreg and bread waste are daily residues that often contribute to environmental impacts. Biodegradation of these residues using BSFL can contribute to a circular economy.

REFERENCES

- Banks, I. J., Gibson, W. T., & Cameron, M. M. (2013). Growth rates of black soldier fly larvae fed on fresh human faeces and their implication for improving sanitation. *Tropical Medicine & International Health*, *19*(1), 14–22. <https://doi.org/10.1111/tmi.12228>
- Barragan-Fonseca, K. B., Dicke, M., & van Loon, J. J. A. (2017). Nutritional value of the Black Soldier Fly (*Hermetia illucens* L.) and its suitability as animal feed – a review. *Journal of Insects as Food and Feed*, *3*(2), 105–120. <https://doi.org/10.3920/jiff2016.0055>
- Barragán-Fonseca, K., Pineda-Mejía, J., Dicke, M., & van Loon, J. J. (2018). Performance of the black soldier fly (diptera: Stratiomyidae) on vegetable residue-based diets formulated based on protein and carbohydrate contents. *Journal of Economic Entomology*. <https://doi.org/10.1093/jee/toy270>
- Bava, L., Jucker, C., Gislón, G., Lupi, D., Savoldelli, S., Zucali, M., & Colombini, S. (2019). Rearing of *Hermetia illucens* on different organic by-products: Influence on growth, waste reduction, and environmental impact. *Animals*, *9*(6), 289. <https://doi.org/10.3390/ani9060289>
- Cai, M., Zhang, K., Zhong, W., Liu, N., Wu, X., Li, W., Zheng, L., Yu, Z., & Zhang, J. (2017). Bioconversion-composting of Golden Needle Mushroom (*flammulina velutipes*) root waste by black soldier fly (*Hermetia Illucens*, Diptera: Stratiomyidae) larvae, to obtain added-value

- biomass and fertilizer. *Waste and Biomass Valorization*, 10(2), 265–273. <https://doi.org/10.1007/s12649-017-0063-2>
- Chiam, Z., Lee, J. T., Tan, J. K., Song, S., Arora, S., Tong, Y. W., & Tan, H. T. (2021). Evaluating the potential of okara-derived black soldier fly larval frass as a soil amendment. *Journal of Environmental Management*, 286, 112163. <https://doi.org/10.1016/j.jenvman.2021.112163>
- da Silva, G. D., & Hesselberg, T. (2019). A review of the use of black soldier fly larvae, *Hermetia illucens* (Diptera: Stratiomyidae), to compost organic waste in tropical regions. *Neotropical Entomology*, 49(2), 151–162. <https://doi.org/10.1007/s13744-019-00719-z>
- De Smet, J., Wynants, E., Cos, P., & Van Campenhout, L. (2018). Microbial community dynamics during rearing of black soldier fly larvae (*Hermetia illucens*) and impact on exploitation potential. *Applied and Environmental Microbiology*, 84(9). <https://doi.org/10.1128/aem.02722-17>
- Diener, S., Zurbrugg, C., & Tockner, K. (2009). Conversion of organic material by black soldier fly larvae: Establishing optimal feeding rates. *Waste Management & Research: The Journal for a Sustainable Circular Economy*, 27(6), 603–610. <https://doi.org/10.1177/0734242x09103838>
- Ewald, N., Vidakovic, A., Langeland, M., Kiessling, A., Sampels, S., & Lalander, C. (2020). Fatty acid composition of black soldier fly larvae (*Hermetia illucens*) – possibilities and limitations for modification through Diet. *Waste Management*, 102, 40–47. <https://doi.org/10.1016/j.wasman.2019.10.014>
- Faisal, M., Gani, A., Mulana, F., & Daimon, H. (2016). Treatment and utilization of industrial tofu waste in Indonesia. *Asian Journal of Chemistry*, 28(3), 501–507. <https://doi.org/10.14233/ajchem.2016.19372>
- Galassi, G., Jucker, C., Parma, P., Lupi, D., Crovetto, G. M., Savoldelli, S., & Colombini, S. (2021). Impact of agro-industrial byproducts on Bioconversion, chemical composition, in vitro digestibility, and microbiota of the Black Soldier Fly (Diptera: Stratiomyidae) larvae. *Journal of Insect Science*, 21(1). <https://doi.org/10.1093/jisesa/ieaa148>
- Gasco, L., Acuti, G., Bani, P., Dalle Zotte, A., Danieli, P. P., De Angelis, A., Fortina, R., Marino, R., Parisi, G., Piccolo, G., Pinotti, L., Prandini, A., Schiavone, A., Terova, G., Tulli, F., & Roncarati, A. (2020). Insect and fish by-products as sustainable alternatives to conventional animal proteins in animal nutrition. *Italian Journal of Animal Science*, 19(1), 360–372. <https://doi.org/10.1080/1828051x.2020.1743209>
- Gligorescu, A., Toft, S., Hauggaard-Nielsen, H., Axelsen, J. A., & Nielsen, S. A. (2018). Development, metabolism and nutrient composition of black soldier fly larvae (*Hermetia illucens*; Diptera: Stratiomyidae) in relation to temperature and Diet. *Journal of Insects as Food and Feed*, 4(2), 123–133. <https://doi.org/10.3920/jiff2017.0080>
- Hopkins, I., Newman, L. P., Gill, H., & Danaher, J. (2021). The influence of food waste rearing substrates on black soldier fly larvae protein composition: A systematic review. *Insects*, 12(7), 608. <https://doi.org/10.3390/insects12070608>
- Rehman, K. ur, Rehman, A., Cai, M., Zheng, L., Xiao, X., Somroo, A. A., Wang, H., Li, W., Yu, Z., & Zhang, J. (2017). Conversion of mixtures of dairy manure and soybean curd residue by black soldier fly larvae (*Hermetia illucens* L.). *Journal of Cleaner Production*, 154, 366–373. <https://doi.org/10.1016/j.jclepro.2017.04.019>
- Julita, U., Lusianti F, L., Eka Putra, R., & Dana Perma, A. (2020). Mating success and reproductive behavior of black soldier Fly *Hermetia illucens* L. (Diptera, Stratiomyidae) in Tropics. *Journal of Entomology*, 17(3), 117–127. <https://doi.org/10.3923/je.2020.117.127>

- Kim, E., Park, J., Lee, S., & Kim, Y. (2014). Identification and physiological characters of intestinal bacteria of the black soldier fly, *Hermetia Illucens*. *Korean Journal of Applied Entomology*, 53(1), 15–26. <https://doi.org/10.5656/ksae.2013.09.0.049>
- Kinasih, I., Putra, R. E., Permana, A. D., Gusmara, F. F., Nurhadi, M. Y., & Anitasari, R. A. (2018). Growth performance of black soldier fly larvae (*Hermetia illucens*) fed on some plant based organic wastes. *HAYATI Journal of Biosciences*, 25(2), 79. <https://doi.org/10.4308/hjb.25.2.79>
- Lestari, A., T.H Wahyuni, T.H Wahyuni, E. Mirwandhono, & N. Ginting. (2021). Maggot Black Soldier Fly (*Hermetia illucens*) nutritional content using various culture media. *Jurnal Peternakan Integratif*, 8(3), 202–211. <https://doi.org/10.32734/jpi.v8i3.5167>
- Li, X., Zhou, Z., Zhang, J., Zhou, S., & Xiong, Q. (2021). Conversion of mixtures of soybean curd residue and kitchen waste by black soldier fly larvae (*Hermetia illucens* L.). *Insects*, 13(1), 23. <https://doi.org/10.3390/insects13010023>
- Liu, C., Wang, C., & Yao, H. (2019). Comprehensive resource utilization of waste using the Black Soldier Fly (*Hermetia Illucens* (L.)) (Diptera: Stratiomyidae). *Animals*, 9(6), 349. <https://doi.org/10.3390/ani9060349>
- Lopes, I. G., Lalander, C., Vidotti, R. M., & Vinnerås, B. (2019). Using *Hermetia illucens* larvae to process biowaste from aquaculture production. *Journal of Cleaner Production*, 251, 119753. <https://doi.org/10.1016/j.jclepro.2019.119753>
- Meneguz, M., Schiavone, A., Gai, F., Dama, A., Lussiana, C., Renna, M., & Gasco, L. (2018). Effect of rearing substrate on growth performance, waste reduction efficiency and chemical composition of Black Soldier Fly (*Hermetia Illucens*) larvae. *Journal of the Science of Food and Agriculture*, 98(15), 5776–5784. <https://doi.org/10.1002/jsfa.9127>
- Muchdar, F., Andriani, R., Juharni, & Wulansari, A. (2021). Effects of different combination of culture medium on growth and nutrition content of black soldier fly larvae (*Hermetia illuens*). *IOP Conference Series: Earth and Environmental Science*, 890(1), 012030. <https://doi.org/10.1088/1755-1315/890/1/012030>
- Nguyen, T. T., Tomberlin, J. K., & Vanlaerhoven, S. (2013). Influence of resources on *hermetia illucens* (Diptera: Stratiomyidae) larval development. *Journal of Medical Entomology*, 50(4), 898–906. <https://doi.org/10.1603/me12260>
- Nyakeri, E. M., Ayieko, M. A., Amimo, F. A., Salum, H., & Ogola, H. J. O. (2019). An optimal feeding strategy for black soldier fly larvae biomass production and faecal sludge reduction. *Journal of Insects as Food and Feed*, 5(3), 201–213. <https://doi.org/10.3920/jiff2018.0017>
- Oonincx, D. G., van Broekhoven, S., van Huis, A., & van Loon, J. J. (2015). Feed conversion, survival and development, and composition of four insect species on diets composed of food by-products. *PLOS ONE*, 14(10). <https://doi.org/10.1371/journal.pone.0222043>
- Opio, C., Gerber, P., & Steinfeld, H. (2012, February 20). *Livestock and the environment: Addressing the consequences of livestock sector growth: Advances in Animal Biosciences*. Cambridge Core. Retrieved March 14, 2022, from <https://www.cambridge.org/core/journals/advances-in-animal-biosciences/article/livestock-and-the-environment-addressing-the-consequences-oflivestock-sector-growth/671AB21EC974B6FBDFA1839E67DE677>
- Pinotti, L., & Ottoboni, M. (2021). Substrate as insect feed for bio-mass production. *Journal of Insects as Food and Feed*, 7(5), 585–596. <https://doi.org/10.3920/jiff2020.0110>
- Putra, R. E., Fatmalasari, Y., Permana, A. D., Kinasih, I., & Rosmiati, M. (2019). Improvement of omega-3 content of black soldier Fly Prepupa (*Hermetia illucens*) fed with combination of marine fish offal and tofu dreg. *BIOTROPIA - The Southeast Asian Journal of Tropical Biology*. Retrieved March 11, 2022, from <https://journal.biotrop.org/index.php/biotropia/article/view/1082>

- Salomone, R., Saija, G., Mondello, G., Giannetto, A., Fasulo, S., & Savastano, D. (2017). Environmental impact of food waste bioconversion by insects: Application of life cycle assessment to process using *Hermetia Illucens*. *Journal of Cleaner Production*, *140*, 890–905. <https://doi.org/10.1016/j.jclepro.2016.06.154>
- Shumo, M., Osuga, I. M., Khamis, F. M., Tanga, C. M., Fiaboe, K. K., Subramanian, S., Ekesi, S., van Huis, A., & Borgemeister, C. (2019). The nutritive value of black soldier fly larvae reared on common organic waste streams in Kenya. *Scientific Reports*, *9*(1). <https://doi.org/10.1038/s41598-019-46603-z>
- Sintawardani, N. (2011). Socio-economic problem on reducing the waste water pollution from tofu processing in the Cibuntu area, Indonesia. Research Center for Physics Indonesian Institute of Science.
- Spranghers, T., Ottoboni, M., Klootwijk, C., Olyn, A., Deboosere, S., De Meulenaer, B., Michiels, J., Eeckhout, M., De Clercq, P., & De Smet, S. (2016). Nutritional composition of black soldier fly (*Hermetia illucens*) prepupae reared on different organic waste substrates. *Journal of the Science of Food and Agriculture*, *97*(8), 2594–2600. <https://doi.org/10.1002/jsfa.8081>
- Susilo, Daniel, et al. "Food Waste Handling Perception in Indonesia: Communicating the Sustainability of Food and Environment." IOP Conference Series: Earth and Environmental Science, vol. 892, no. 1, 2021, p. 012109., <https://doi.org/10.1088/17551315/892/1/012109>.
- Tavill, G. (2020). Industry challenges and approaches to food waste. *Physiology & Behavior*, *223*, 112993. <https://doi.org/10.1016/j.physbeh.2020.112993>
- UNEP Food Waste Index Report 2021. UNEP. (2021). Retrieved March 6, 2022, from <https://www.unep.org/resources/report/unep-food-waste-index-report-2021>
- Varelas, V. (2019). Food wastes as a potential new source for edible insect mass production for food and feed: A Review. *Fermentation*, *5*(3), 81. <https://doi.org/10.3390/fermentation5030081>