INSECT DIETS, NUTRITION AND PHYSIOLOGY

Substrate moisture content and relative humidity affect growth and gaseous emissions in black soldier flies

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Black soldier fly larvae require a high moisture content of the substrate, while at the end of the process this needs to decrease for automated harvesting. The drying process is influenced by scale, initial dry matter (DM) content and relative humidity (RH), with likely consequences for larval development and gaseous emissions. A large scale (300 kg of substrate in five trays per replicate) experiment was conducted to quantify these effects, varying starting DM contents (31 vs 34%), and RH (50 vs 70%). During 13 days samples of larvae and substrate were taken daily and analyzed for DM, N, and fat. Substrate pH and NO_2 emissions were determined daily, while substrate temperature, O_2 consumption, CO_2, CH_4, and NH_3 production were measured continuously in our climate respiration chambers. Initial growth was higher at the higher DM and then lower in the last three days. A higher RH increased growth in the middle of the growth period. Larval N content decreased over time and was higher in the high DM (D3-13). Fat content increased over time and more so in the high DM (D3-11). Substrate temperatures increased over time, with initially higher temperatures in the high DM (D1-9) and higher RH (D0-4). Substrate DM increased over time and stayed higher for the higher DM. This difference increased over time and a lower RH increased the drying process (D8-13). During the experiment pH increased, and this increase was quicker for the high DM (D6-11). A higher RH led to a slightly higher pH at D9-11. Final tray yields were higher for a lower DM (3.5 vs 3.8 kg) and less substrate was leftover (7.3 vs 9.2 kg). Greenhouse gas and NH_3 emission patterns were affected by both DM content and RH. The higher DM led to earlier and lower peaks of CO_2 emissions. Higher DM and higher RH increased NH_3 emissions, whereas the opposite was true for CH_4. In conclusion, this is the first large scale study reporting the effect of both RH and moisture content on production characteristics and gaseous emissions during a full rearing cycle. The collected data can be used to find an optimal balance between larval production, sievability, and gaseous emissions.

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