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SHORT COMMUNICATION

Survival Rates and Growth of Black Soldier Fly Larvae Reared on a Blend of Wheat Bran and Soy Pulp

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Abstract

In this study, we investigated the effects of a blend of wheat bran and soy pulp on the survival and growth of black soldier fly (BSF) larvae. Third-and fourth-instar BSF larvae were fed the same diet. The experimental groups were as follows: 200-g blend of wheat bran and soy pulp + 20 g third-instar BSF larvae (T1) and 200-g blend of wheat bran and soy pulp + 20 g fourth-instar BSF larvae (T2). Each experiment was performed in three replicates. The survival rate and growth of the fourth-instar BSF larvae were higher than those of third-instar BSF larvae. The higher growth of the fourth-instar BSF larvae might have resulted from consuming a large amount of a blend of wheat bran and soy pulp, which has a high protein content.

Key words : Black soldier fly larvae, Growth, Soy pulp, Survival rate, Wheat bran

1. Introduction

The most abundant and widely distributed organisms on Earth are insects, which consume most organic matter as food, acting as environmental decomposers by decomposing the byproducts of plants, animals, and organic waste (Kim et al., 2008). Among insects with such habits, the black soldier fly (BSF; *Hermetia illucens*), used in environmental purification, decomposes and purifies organic waste generated by agriculture and human activities (Kim et al., 2008). Excess organic waste has broad environmental effects. In particular, livestock waste production has caused a sharp increase in environmental complaints, such as bad odors; therefore, new technologies are urgently needed to overcome this problem. The most effective method to reduce the dry matter of manure and nutrients, which can be detrimental to the environment, is using BSF larvae. BSF feeds during the larval stage in places where livestock waste is deposited, such as compost heaps (Sheppard et al., 2002; Kim et al., 2008; Park et al., 2013). A secondary use of BSF is soldier fly castings, which improve nutrient availability in the soil and root growth (Choi et al., 2013; Lee et al., 2013). Moreover, BSF larvae and pupae are mostly composed of fat and protein; therefore, they can be used as animal feed (Park et al., 2012; Henry et al., 2015; Spranghers et al., 2016). Hence, BSF larvae may be an important

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alternative source of protein as a cost-effective addition to animal feed (Schez-Muros et al., 2014). However, no studies have investigated the feasibility of utilizing BSF larvae reared on soy pulp as a source of protein to improve animal feed. Soy pulp is a surplus material obtained from the manufacturing of soybeans, such as tofu. Owing to the high levels of protein in soy pulp after processing, it can be used as a material for insect larvae. Therefore, the objective of the present study was to assess the effects of feeding a blend of wheat bran and soy pulp on the survival rate and growth of third- and fourth-instar BSF larvae.

2. Materials and Methods

Wheat bran and soy pulp were obtained at a market near Geumsan and used as feed for the BSF larvae. Third-and fourth-instar BSF larvae were purchased from Circular Bio (Anseong, South Korea) and reared for 15 d in a 12×10×10 cm plastic box with a lid that had four perforated holes to allow ventilation. Rearing conditions were 24±2℃, relative humidity of 55±10%, and 15h:9h light:dark cycle. Insect status was monitored daily. The insects were divided into third-(T1) and fourth-(T2) instar groups, with three replicates per group, using a completely randomized block design method. To compare the survival rates and growth of third-and fourth-instar BSF larvae reared on a blend of wheat bran and soy pulp, the sole feed of wheat bran, a representative food for insects, was excluded. The treatment groups were:

Treatment 1 (T1)
200-g blend of wheat bran and soy pulp + 20 g third-instar BSF larvae

Treatment 2 (T2)
200-g blend of wheat bran and soy pulp + 20 g fourth-instar BSF larvae

The survival rate was calculated as the difference between the total number of live larvae before the start of the experiment and that after the end of the experiment. Growth was measured every 5 days using a scale and calculated as the difference in the weight recorded. Statistical analyses were performed using SAS, and the *t*-test was used to compare survival rates and growth between treatment groups. Statistical significance was set at $p < 0.05$.

3. Results and Discussion

Fig. 1 presents the survival rate when a blend of wheat bran and soy pulp was fed to BSF larvae. The growth stage of BSF larvae did not significantly affect the survival rate ($p < 0.05$). However, at the end of the experiment, the survival rate was higher in fourth-instar BSF larvae than in third-instar BSF larvae. Determining whether the growth conditions of the insect or unknown components contained in the wheat bran and soy pulp blend affect the survival rate is difficult. Song et al.(2018) reported that the survival rates of *Protaetia brevitarsis* and *Allomyrina dichotoma* larvae reared on fermented sawdust with 30% wheat bran are significantly lower than those of controls reared on fermented sawdust without supplementation. Thus, they suggested that fermented sawdust with a high density of wheat bran is not suitable for either insect.

The growth of BSF larvae fed with a blend of wheat bran and soy pulp is summarized in Fig. 2. The growth of third-and fourth-instar BSF larvae was significant only on day 15 ($p < 0.05$). However, no effect was observed at 0, 5, or 10 days ($p > 0.05$). On days 0 and 5, the growth of third-instar BSF larvae increased; that of fourth-instar BSF larvae showed a more prominent increase than that of third-instar BSF larvae from day 5 to day 15. Supplying a food source containing sufficient protein to third-instar BSF

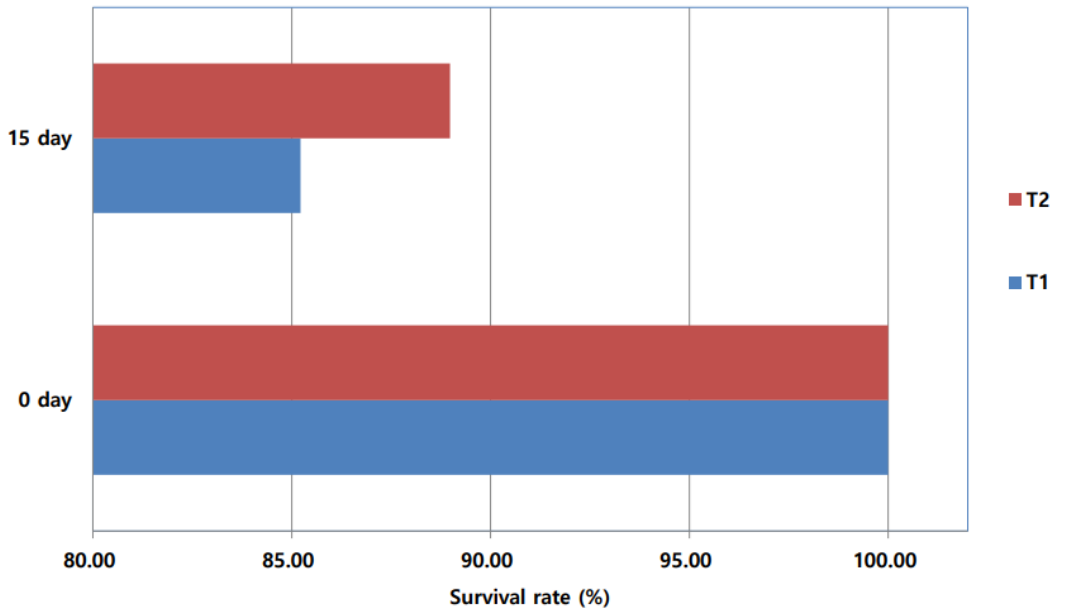

Fig. 1. Survival rates of BSF larvae reared on a blend of wheat bran and soy pulp for 15days. T1 = 200-g blend of wheat bran and soy pulp + 20 g third-instar BSF larvae; T2 = 200-g blend of wheat bran and soy pulp + 20 g fourth-instar BSF larvae.

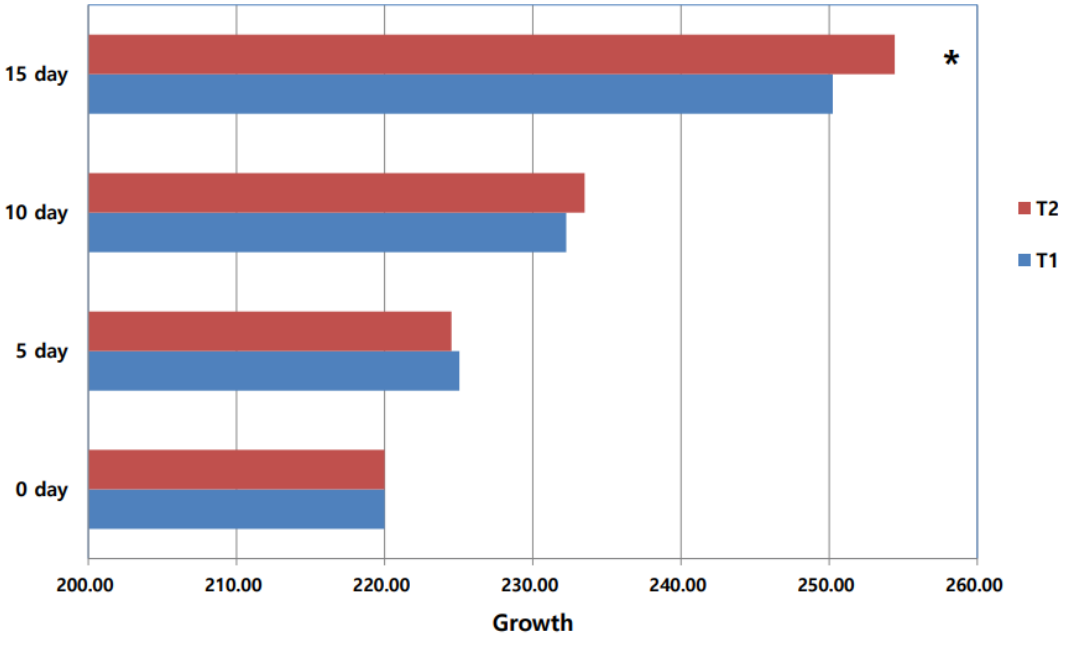

Fig. 2. Growth of BSF larvae reared on a blend of wheat bran and soy pulp for 15 days. T1 = 200-g blend of wheat bran and soy pulp + 20 g third-instar BSF larvae; T2 = 200-g blend of wheat bran and soy pulp + 20 g fourth-instar BSF larvae. *Marks indicate significant differences ($p < 0.05$).

larvae not only increases the bioconversion rate via the increase in the weight of the larvae but also shortens the larval growth period, thereby increasing the protein content of the larvae (Nguyen et al., 2015; Oonincx et al., 2015). This could be owing to the higher consumption in fourth-instar larvae than in third-instar larvae because of the high protein content of the soy pulp. In general, by-products generated during agricultural and industrial processing (approximately 20% of weight) are rich in diverse nutritional components, such as proteins, fibers, and bioactive materials (Azevêdo et al., 2012; Comunian et al., 2021). Thus, these products could serve as alternative sources of insect feed. In Koo et al.(2023), among agricultural by-products, the crude protein content was high in the group treated with citrus fruit waste, and the crude protein content of the larvae of BSF was the highest. Our results are in agreement with those reported by Song et al.(2017), who provided a scientific basis for the use of soybean curd cake as a nutritional feed source to promote larval growth.

4. Conclusions

In this study, a blend of wheat bran and soy pulp was used as a substitute for BSF larval feed. The survival rate and growth were higher in fourth-instar BSF larvae than in third-instar BSF larvae. In particular, increasing the growth of fourth-instar BSF larvae is considered to be the result of consuming a large amount of soy pulp, which has a high protein content.

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