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Amino acid composition and requirements of black soldier fly larvae

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BioBoost – WP4 Report Amino acid composition and requirements of black soldier fly larvae

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Amino acid composition and requirements of black soldier fly larvae

This report is based on Chapter 7.1.4: "Nutritional requirements" and 7.1.5: "Optimizing artificial diet" of the Insect Breeding report of December 2019

7.1.5: Nutritional requirements

Artificial diets with different protein contents were tested to determine the protein requirements of BSF larvae. If we provided an artificial diet with only 5% protein on dry matter, the larval yield significantly reduced compared to a control substrate of chicken feed with 20% protein on dry matter. This was due to a lower individual larval weight (reduction of 44%, Figure 1) and higher mortality (increase of 20%). For a 10% protein diet, larval weight reduction was only 38% and there was no increased mortality. In order to better understand the nutritional requirements of the larvae, HPLC analyses were performed to assess the amino acid (AA) profiles of the diets (Figure 2) and the larvae (Figure 3).

For the larvae the amount of protein on dry matter was similar and also no difference in the AA profile was detected. This supports the findings from literature that the AA profile of insects is not so much determined by the rearing substrate. Also protein contents are between relatively narrow boundaries, especially when this is compared to fat or ash contents (Makkar et al., 2014; Spranghers et al., 2017). When we compare the AA profiles with values from literature (Figure 3), similar levels for (assumedly) essential AAs like lysine, threonine, methionine, valine and isoleucine were found. This confirms that the protein value of the larvae as animal feed is largely independent of the substrates used to rear them. Consequently, low value side streams can be upgraded by the larvae into valuable protein rich biomass with high content of essential amino acids.

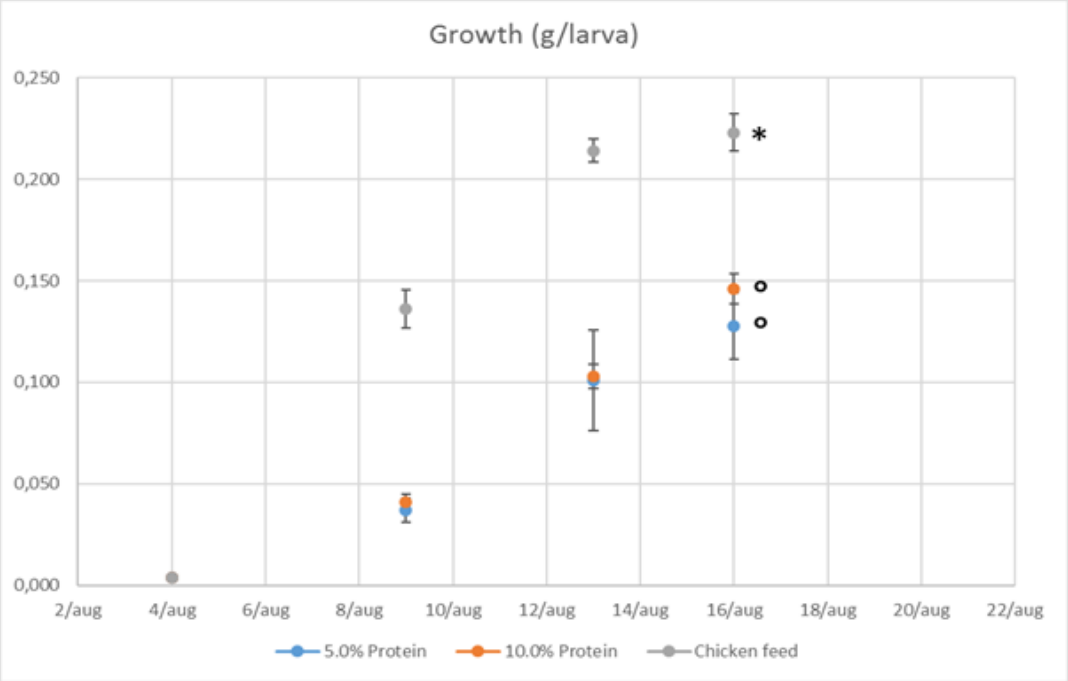

Figure1: Evolution of the average individual weight of larvae grown on artificial substrates (iso-energetic mixtures of soy protein, potato starch, premix and sunflower oil) with different protein levels and larvae grown on a control substrate (chicken feed / water: 30/70) . Different signs (or °) indicate statistically significant differences.*

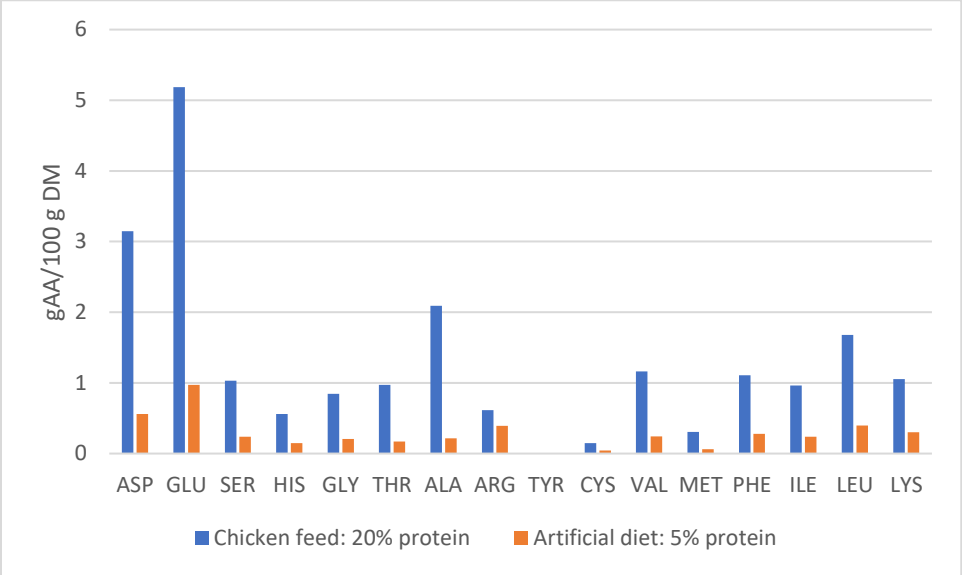

Figure 2: AA profiles of BSF diets

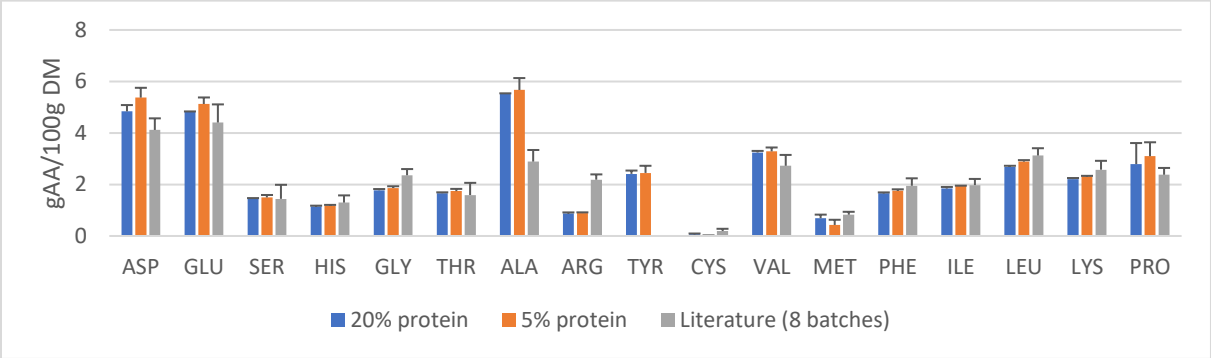

Figure 3: AA profiles of BSF larvae reared on different diets

7.1.5 : Optimizing artificial diet

In this experiment the dietary levels of 2 AAs, which are the most essential and limiting for the growth of farmed animals, were adapted (Table 1). From the resulting yield (Figure 4), it appeared that there were no significant differences between the artificial diets. So an iso-energetic diet with lower amounts of lysine and methionine (Sugar diet), yielded the same larval biomass as diets that contained equal amounts of lysine and lysine + methionine as the chicken feed control. However, from the AA profiles (Figures 5 and 6) it could be deduced that larvae reared on the Sugar diet contained less protein than the other semi artificial diets (35% compared to 37% for the Lysine diet and 41% for the Lysine + Methionine diet). This interesting finding indicates that just like for mammals and birds, lysine and methionine are essential AAs for insects. However, in this case, shortage of these AAs didn't influence the growth and mortality of the larvae. It should also be noted that, in this experiment, the results for

proline were not so reliable. If this AA is not considered, differences in protein contents are still visible but much less pronounced.

Table 1: semi artificial diets with different amounts of essential amino acids

Lysine	Lysine + Methionine	Sugar	Chicken feed
50 g Chicken feed/water	50 g Chicken feed/water	50 g Chicken feed/water	100 g Chicken feed/water
9.57 g Sugar	9.52 g Sugar	9.75 g Sugar	
0.18 g Lysine	0.18 g Lysine		
	0.05 g Methionine		

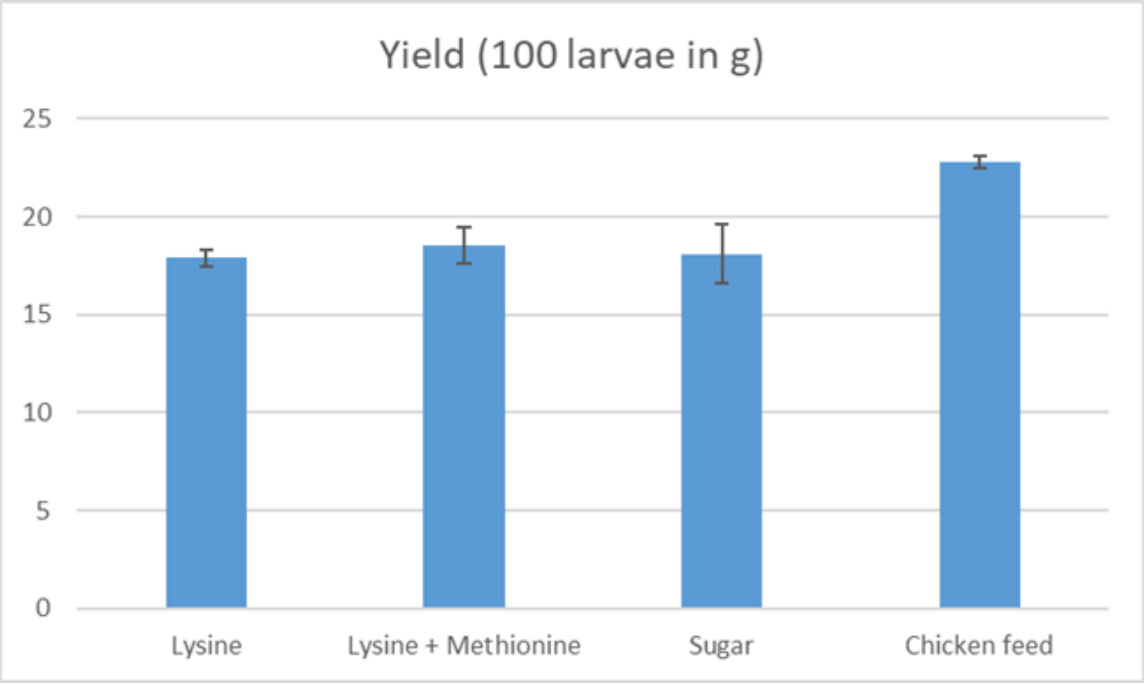

Figure 4: yield of 100 larvae reared on different (semi artificial) diets

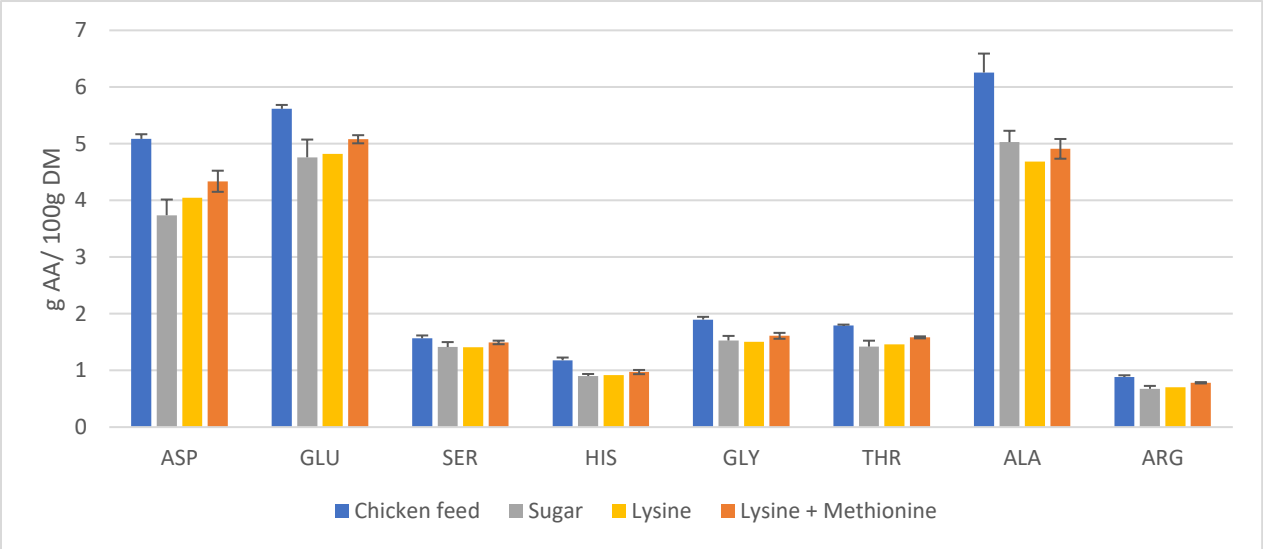

Figure 5: AA profile of BSF larvae reared on different (semi artificial) diets

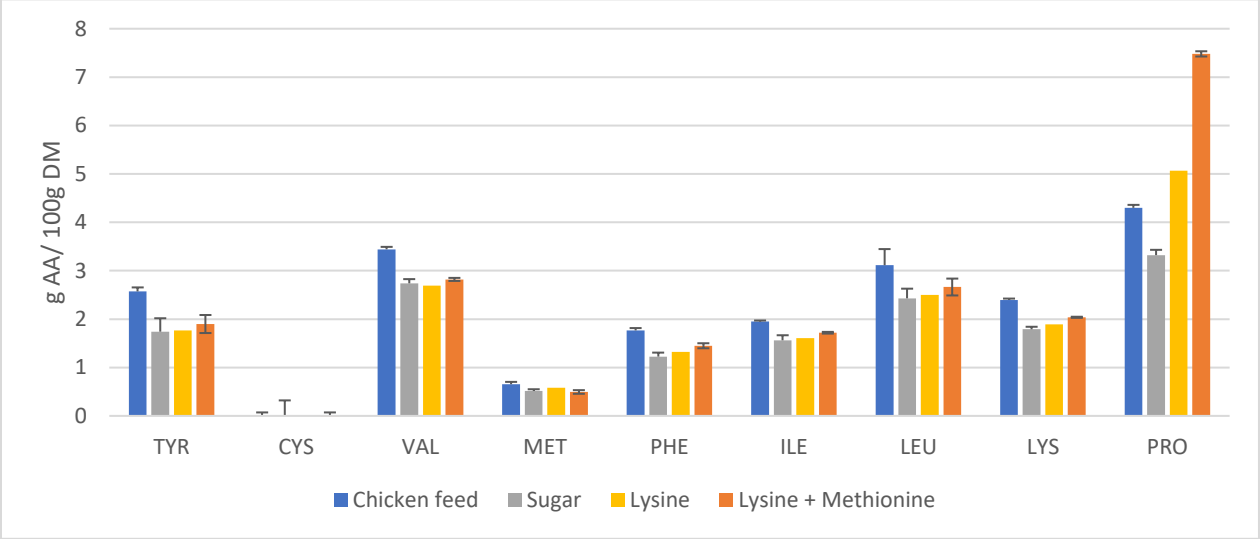

Figure 6: AA profile of BSF larvae reared on different (semi artificial) diets

References

Makkar, H. P., Tran, G., Heuzé, V., & Ankers, P. (2014). State-of-the-art on use of insects as animal feed. *Animal Feed Science and Technology*, *197*, 1-33.

Spranghers, T., Ottoboni, M., Klootwijk, C., Ovyn, A., Deboosere, S., De Meulenaer, B., ... & De Smet, S. (2017). 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.