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Effects of lysine supplementation on Black Soldier Fly larvae

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Introduction

Edible insects may contribute to a satisfactory supply of animal protein for the growing world population in the future. This may be directly by utilizing them for food or indirectly by feeding them to other livestock like pigs or poultry. The Black Soldier Fly, *Hermetia illucens*, is a promising insect species for that purpose since it is able to convert a variety of organic materials into biomass, resp. protein. In pigs and poultry, production of protein biomass is limited by the supply of amino acids such as lysine and others. Feeding these animals with lysine-rich feed (e.g. insects) could facilitate growth and protein increase.

Therefore, the aim of the study was to elucidate, if it is generally possible to influence the larval lysine content by enrichment of the substrate with crystalline lysine.

Materials and Methods

Substrate consisted of mostly cooked and homogenized food (oat flakes, minced meat incl. brew, broccoli, eggs, noodles, rice, potatoes, carrots, cauliflower, red cabbage, curd, sugar, soaked bread, mozzarella) aliquoted at 120 g in plastic food boxes. In four groups, crystalline *L*-lysine was added up to three percent (0, 0.5, 1.0, 3.0 %) and 80 Black Soldier Fly larvae were added per substrate aliquot. In total, 320 to 560 larvae were applied per approach and ten repetitions were performed. The general workflow is illustrated in Fig. 1.
All values were statistically analyzed using ANOVA followed by Bonferroni post test.

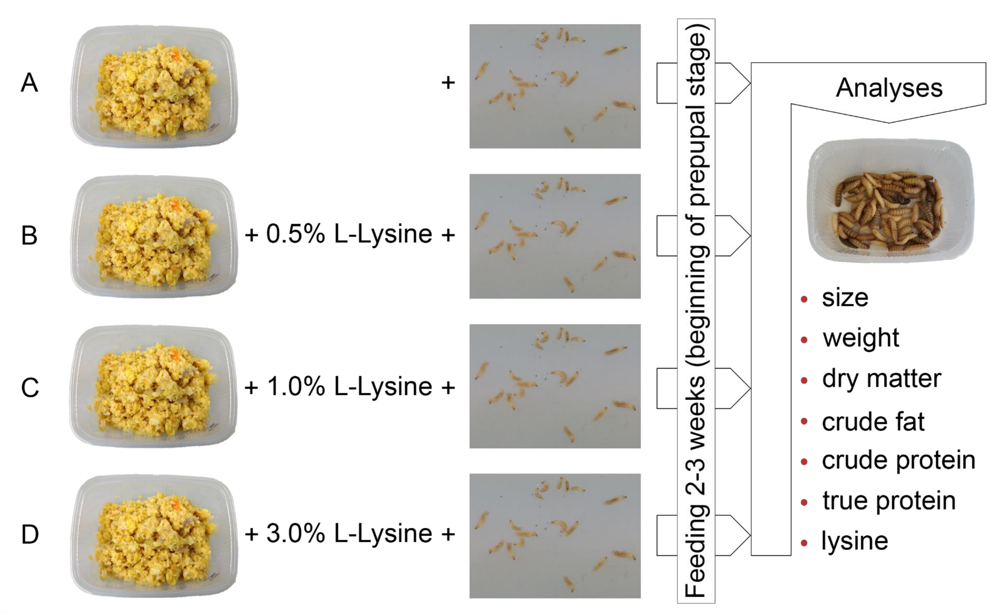

Fig. 1: Scheme of project workflow

Results

Supplementation of substrate with lysine expectedly resulted in higher crude protein and lysine content of the substrate. However, neither larval lysine content nor crude protein content increased substantially (Fig. 2). Besides this, elevated lysine led to decreased survival rates and, especially when three percent lysine were added, to a substantially lower rate of prepupae. Larvae also were smaller in presence of three percent lysine and tended to weigh less (Table 1).

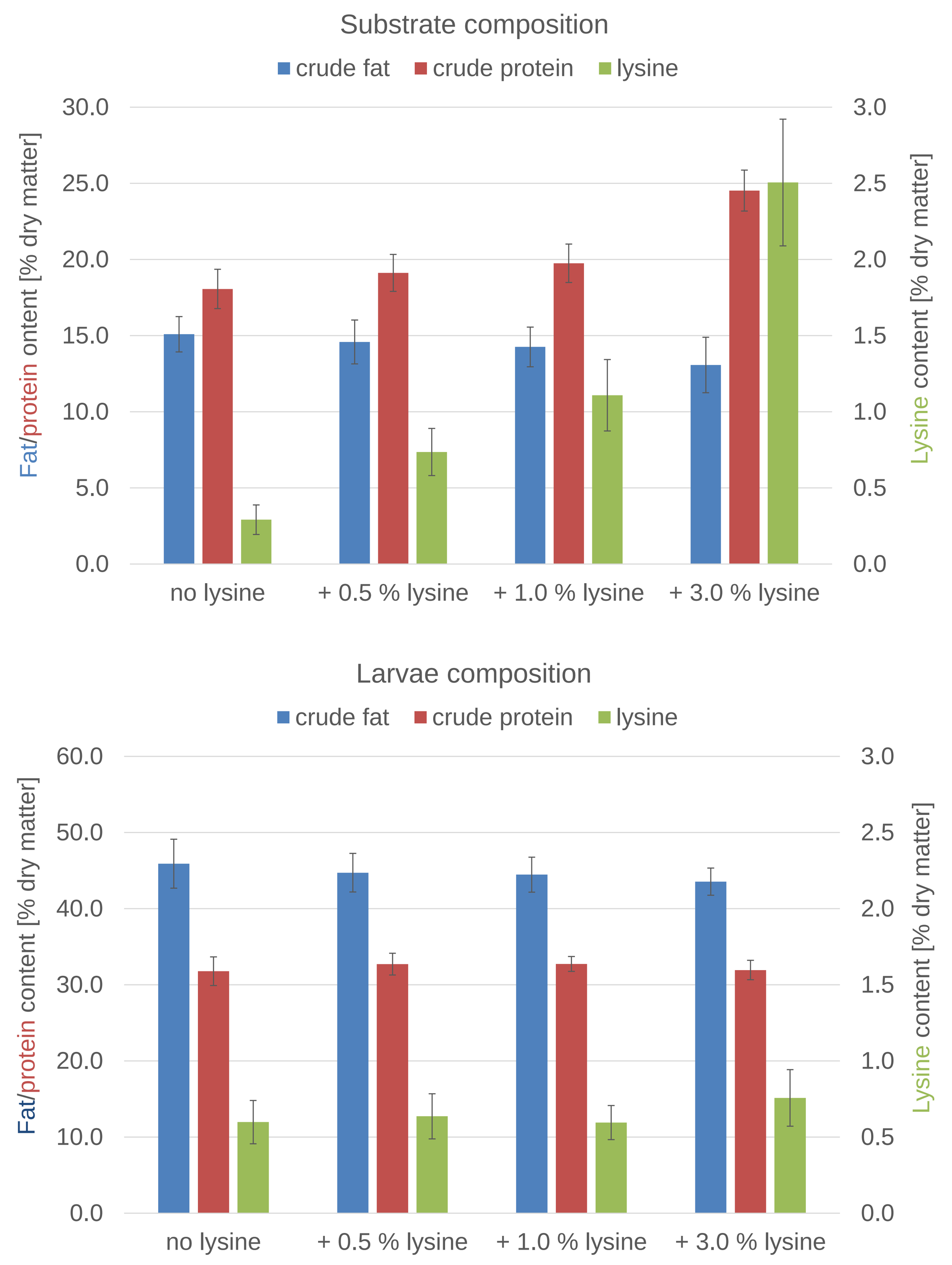

Fig. 2: Crude fat, crude protein and lysine content of substrate (top) and *Hermetia illucens* larvae (bottom) after addition of crystalline lysine

Although statistically not significant, lysine content seemed to be higher in larvae fed with substrate supplemented with three percent lysine. Analysis of true:crude protein ratio revealed a coincidental decrease (0.79, 0.78, 0.77, 0.69 for groups with no, 0.5, 1.0, and 3.0 % lysine added, respectively).

Table 1: Survival rate, rate of prepupae, mean larval size, and mean larval weight after feeding larvae substrate containing different amounts of lysine

Group	Survival rate [%]	Prepupal rate [%]	Mean size [mm]	Mean weigth [mg]
no lysine	90.6 ± 5.7 [a]	17.2 ± 13.0 [a]	22.4 ± 0.7 [a]	250.3 ± 14.5 [a]
+ 0.5 % lysine	88.5 ± 6.2 [a]	28.0 ± 16.9 [b]	22.6 ± 0.9 [a]	258.2 ± 10.1 [a]
+ 1.0 % lysine	81.4 ± 9.4 [b]	23.4 ± 17.2 [ab]	22.1 ± 0.9 [a]	251.6 ± 6.8 [a]
+ 3.0 % lysine	69.1 ± 11.7 [c]	1.7 ± 6.3 [c]	20.3 ± 1.7 [b]	232.9 ± 42.5 [a]

Different letters indicate statistically significant differences ($p < 0.05$)

Conclusions

Since the lysine content of Black Soldier Fly larvae tended to increase in dependence of rising substrate lysine concentrations, the amino acid is apparently ingested by the larvae to some extent. The detected decrease of true:crude protein ratio indicated, however, that the lysine is not incorporated into larval protein mass. The slightly elevated lysine values may be explained by presence of the unchanged amino acid in the larval intestine or on the larval surface.
In general, data showed that the lowest lysine concentration of approx. 0.3 % (no lysine added) seems sufficient for optimal growth and protein formation and that addition of crystalline lysine did not lead to a higher larval protein content.

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