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Recycling of organic residues by black soldier fly larvae - influence of substrate on larval composition

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The concept of closed ecological cycles has a high priority in organic farming. As the larvae of the black soldier fly are able to utilize organic residues and convert them into high-quality protein and fat, the larvae could play a role in recycling local organic residues into feed for fish, poultry and pigs and partially replace imported protein feeds. In this work, a wide range of residues was tested as feed components for black soldier fly larvae.

Total C and S of feed substrates and larvae were determined by CNS analyzer. Crude protein/ N_{tot} was analyzed by the Kjeldahl method; crude fat after acid digestion. For the analysis of P_{tot} and other elements the samples were digested by dry ashing, dissolved in dilute HCl and measured by ICP-OES.

The yield of larval dry matter ranged from 0.10 to 0.23 kg per kg feed dry matter (DM). The highest larval DM was obtained with substrates of bread residues and wheat bran and of distiller's grain solubles (DDGS) and pasta residues. The lowest larval DM and the lowest yield of larval protein were obtained when feeding with substrates containing beet pulp or potatoes.

Crude protein contents of the larvae ranged from 33% to 52% DM, the maximum values almost equalling soybean extraction meal, but still below fish meal. High crude protein contents in the feed did not always correlate with high larval contents. The yield of larval protein was 0.105 kg per kg feed DM at maximum, with a substrate containing rapeseed extraction meal and pasta residues. Substrates of brewer's grains and pasta residues and of DDGS and pasta residues yielded 0.101 kg kg^{-1} and 0.98 kg kg^{-1} , respectively.

Larval crude fat contents ranged between 18% and 38% DM. Of the feed substrates with high DM and protein yields, only that of rapeseed extraction meal and pasta residues achieved a crude protein/crude fat ratio >2.

Phosphorus contents of the larvae were 6.9 - 11.5 g kg^{-1} DM, sulfur contents 3.3 - 6.1 g kg^{-1} . Highest P and S contents were found in larvae fattened on substrates with particularly high P and S contents, such as of corn steep liquor and wheat bran, or of rapeseed extraction meal with maize or pasta residues.

Calcium was enriched in the larvae. With the exception of larvae from Ca-rich feed substrates such as rapeseed extraction meal or beet pulp, which had Ca contents of 20 and 30 g kg^{-1} DM,

respectively, the Ca contents of the larvae were in the range of soybean extraction meal, 3.4 to 10.5 g kg⁻¹ DM.

Cu contents ranged from 5.7 to 13.9 mg kg⁻¹ DM, with the exception of larvae fed with brewer's grains, which had 24.7 mg kg⁻¹ Cu.

The results show that crude protein and crude fat content of the larvae vary greatly with different feed substrates. In addition to these quality characteristics, the substrate also influences the contents of other nutrients such as P, Ca, Cu, etc. This knowledge can be used specifically in different applications of the larvae in feed production.