Effects on egg quality and intestinal villi of black soldier fly (*Hermetia illucens*) larvae and pre-pupae as a replacement for soybean protein and oil in layer diets

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Recently, insects have been used as livestock feed to maintain the sustainability of animal production. This study was conducted to evaluate black soldier fly (BSF) larvae and pre-pupae as a substitute feed for soybean meal and oil. For this experiment, 265 day-old female Boris browns were divided into seven feeding groups: one control group (basal diet), two non-defatted groups (larvae or pre-pupae), two defatted groups (larvae or pre-pupae), and two oil groups (larvae or pre-pupae). The results showed that hen-day egg production, egg weight, body weight, and feed conversion ratio were not affected by the feed. Moreover, in the egg quality test, the Haugh unit (HU) and egg yolk/egg white ratio were not affected by adding BSF. Eggshell strength tended to improve in the larvae protein and oil group (*p* < 0.1). This is because BSF larvae are richer in minerals, such as calcium, than BSF pupae and other insects (K.B. Barragan-Fonseca et al., 2017). In the intestinal tract analysis, the ileum villi were significantly elongated (*p* < 0.05) in the groups fed BSF larvae protein and oil. We think this is because polysaccharides, such as insect chitin, may increase the number of organic acids in the lower gastrointestinal tract, but the details are unknown. As a result, BSF protein and oil can be safely used as soybean protein and oil substitutions. In addition, our results suggest that eggshell strength and ileum villi length may be improved in groups fed BSF larvae protein and oil.