Effect of the use of *Hermetia illucens* larvae to replace fish meal on the growth performances of *Labeo rohita* post-larvae

M.K.C. Priyadarshana[1*], C.N. Walpita[2], H.A.D. Ruwandeepika[2], M.P.S. Magamage[2], P.M. Withanage[3]

[1] Faculty of Graduate Studies, Sabaragamuwa University of Sri Lanka, P.O. Box 02, Belihuloya, Sri Lanka
[2] Department of Livestock Production, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka, P.O. Box 02, Belihuloya, Sri Lanka
[3] National Aquaculture Development Authority, Carp Breeding Center-Udawalawe, National Aquaculture Development Authority, Udawalawe, Sri Lanka
[*] kasunc@agri.sab.ac.lk

1. Introduction

Black soldier fly (BSF) is an insect species that has received much concern in the animal feed industry, including aquaculture. Since BSF is a dipteran with a complete life cycle, the larval stage was already identified as a possible feed ingredient for animals (Bosch et al., 2019). Searching for alternative protein sources for expensive fishmeal, led nutritionists to find many possible sources including soybean meal, corn gluten meal, rapeseed meal and cotton seed meal like plant sources. Availability of anti-nutrient factors and imbalanced amino acid profiles of plant nutrients made them unreliable for use in aqua-feed industry (Daniel, 2018). Animal protein sources such as insects (i.e., yellow meal worm, BSF larvae), have been identified as alternative sources and however, still research is being conducted over different fish species, since the literature evidenced that the reliability of insects were extremely species dependent (Priyadarshana et al., 2021).

Therefore, the present study investigated the effect of BSF larva as a feed ingredient for *Labeo rohita*. *L. rohita* was considered the foremost fish species that thrives Sri Lankan freshwater bodies, since it was demanded as a major food fish species among Sri Lankans (Pushpalatha, & Chandrasoma, 2018). Since, Indian carps including *L. rohita* were not capable of being bred naturally in the Sri Lankan waters, National Aquaculture Development Authority (NAQDA) was performing the breeding activities. Captively bred *L. rohita* larvae were kept in tanks until they were released into the reservoirs, and consequently, a good quality and a low-cost feed was indispensable. Therefore, this study has evaluated the effect of BSF larva as a feed ingredient for the post-larval stage of *L. rohita*.

2. Materials and Methods

Experimental diets and feeding trial

A meal from BSF larva was processed by partially defatting, drying and grinding the harvested larvae. Four feeds were prepared to be iso-caloric (3100 kcal/kg), iso-lipidic (10%) and iso-proteic (35%) manner, by incorporating different feed ingredients i.e., rice bran, coconut poonac, maize, fishmeal, BSF larval meal, fish oil, L-lysine, DL-Methionine, Vitamin-mineral premix. BSF larva meal was used to replace over fishmeal at 04 different levels i.e., 0%, 25%, 50% and 75% to prepare 04 experimental feeds.

Four days old *L. rohita* post-larvae were introduced into cement tanks at a stocking density of 75 post-larvae per tank (tank volume=0.2 m^3). Fish were fed to apparent satiation, thrice a day and tanks were cleaned by syphoning with a frequency of once in two days.

Growth performances

Body weight (BW), body length (BL) measurements of post-larvae were obtained at the beginning and the end of the feeding trial. Water quality parameters (temperature, pH and dissolved oxygen) were measured with a frequency of once a week. Mortality of the fish was recorded daily and survival rates of each treatment group was determined separately at the end of the experiment.

Statistical analysis

IBM SPSS Statistics (version 21.0) software and One-way ANOVA was used to analyse data where the mean comparison was performed using, Duncan's Multiple Range Test ($p<0.05$).

3. Results and Discussion

The results implied that the incorporation of BSF larva meal, did not affect the growth performances up to 25% inclusion rate, since growth performances were significantly higher ($p<0.05$) in 0% and 25% BSF larva diet groups where the BW gain, BL gain and specific growth rate (SGR), values in 0% and 25% BSF larva diet groups were 0.164±0.004 g and 0.163±0.003 g, and 1.579±0.052 cm and 1.578±0.03 cm, 18.015±0.301 % day^{-1} and 17.958±0.101 % day^{-1} respectively. However, the growth performances were seriously affected over 25% inclusion. Body weight gain, BL gain and SGR values were negatively correlated with 50% and 75% BSF diet groups. Similar results were observed in African catfish, *Clarias gariepinus* (Talamuk, 2016), Siberian sturgeon *Acipenser baerii* (Caimi et al., 2020) and Rainbow trout *Oncorhynchus mykiss* (St-Hilaire et al., 2007). BSF larva meal 0% and 25% diet groups showed the highest Protein Efficiency Ratio (PER) values (2.235±0.06 and 2.339±0.037 respectively) whereas 50% and 75% exhibited the lowest (1.965±0.074 and 1.713±0.059 respectively). Since, PER is a reflection of the quality of the proteins (Muin et al., 2017), 0% and 25% feeds might comprise of high-quality proteins. Feed Conversion ratio (FCR) values of the 0% (1.705±0.046) and 25% (1.629±0.026) dietary groups were also significantly lower ($p<0.05$) than those of 50% (1.941±0.074) and 75% (2.226±0.079). A feeding study performed with *Chanos chanos* revealed that diets with poor nutrients and energy deficits as the possible reasons for poor FCR values (Icamina, 2012). As supported by the most of previous studies, chitin was found as the possible cause for growth retardation at higher incorporation levels of BSF larva meal (Kroeckel et al., 2012). Since, chitin is an indigestible polysaccharide for most of the organisms (Rahman & Koh, 2014), digestible energy deficits of the feeds could be possible, though the gross energy values of the feeds in this study seemed equal. Since, chitin a nitrogenous polysaccharide, the apparent crude protein contents of the diets might be lesser than the actual value. Consequently, the protein to energy ratio might not be at optimum levels, and therefore, the proper utilization of energy might not be achieved by the fish. Therefore, further studies are required to clarify this matter.

The survival of post-larvae was not affected ($p<0.05$) by the experimental diets and were within the range of 87.56%±0.76 – 89.33%±3.52. Water quality parameters also remained consistent within the treatments throughout the experimental period; since, the removal of faecal matter and feed residues were done frequently.

4. Conclusions

Black Soldier Fly larva in the diets of *L. rohita* post-larvae do not affect the growth performances up to 25% incorporation level. However, the growth performances have been subsided at 50% and 75% incorporation levels. Therefore, the maximum level of 25% BSF

larvae meal could be incorporated as the protein source in *L. rohita* post-larvae diets to retain optimum growth and survival rates.

5. References

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