

Growth response of rainbow trout (*Oncorhynchus mykiss*) on substitution of shrimp meal by different protein sources

Suman Dheke and Surya Ratna Gubhaju

Central Department of Zoology, Tribhuvan University, Kirtipur, Nepal

Abstract

Shrimp meal (SM) is costly major protein source of trout feed in Nepal. The present work is a feeding trial to develop cost effective formulated trout feed replacing SM by synthetic amino acids (SA), silkworm pupae (SWP) or silkworm moth (SWM). The four diets were prepared iso-nitrogenous with 44.44 (± 0.5) % protein. The trial was conducted for eight weeks in three replications for each diet in random block design (RBD). For which, fry (average 0.31g) were stocked in twelve cages (0.5m^3) kept in a raceway pond at a density of 2000 fry m^{-2} . The feed was given 8 to 10 times a day to satiation. SWP feed showed significantly higher weight gain ($p < 0.5$). Mortality rates of fry were found statistically insignificant ($p > 0.05$) in SM, SWP and SWM feed but significant highest mortality rate (77%) was observed in synthetic amino acid. Lowest feed conversion ratio (FCR) was 1.33 recorded in SWP feed. However, FCR was calculated statistically insignificant ($p > 0.05$) in all four diets. Study concluded silkworm meal could be a proper substitute in rainbow trout feed if it is locally available.

Keywords: FCR, protein, silkworm meal, survival rate, weight gain

Introduction

Nepal has diverse native cold water fishes but commercial production of them has not yet been started due to the lack of overall technical knowhow. Exotic rainbow trout (*Oncorhynchus mykiss*) is introduced (1990) and commercially exploited (from 1995 and 1998) in Nepal to expedite comparative advantage of climatic condition and coldwater resource. Trout farming is an intensive system with the use of 'nutritionally-complete formulated diets'. Aquaculture system becomes economically profitable with the input of low cost nutritionally balanced feed. As fish feed occupies about 40-60% of total cost of fish culture (Akiyama et al. 1992). Formulation of fish feed from locally available inexpensive ingredient is immensely required for the expansion of trout industry in Nepal. Use of SWP in the substitute of Fish Meal (FM) was reported in several research works. Rangacharyulu *et*

al. (2003) and Hossain et al. (1997) used fermented SWP, fish silage and boiled silkworm pupae in place of fishmeal. Nanda (1967) also reported processed silkworm pupae as excellent source of protein in fish feed. Nataraj and Basavanna (1996) reported protein concentration of silkworm pupae as supplement/substitute to fish meal. Singh et al. 2008 reported that dead silkworm pupae and moths could also be used as fish feed. Swamy and Devraj (1994) reported higher fat and protein content in silkworm pupae than plant proteins.

Materials and Methods

Experimental site and diets

The experiment was conducted for 8 weeks at private farm in Dhading. The fry were graded for uniform size and length (average 0.31 g and 2.9 cm). Four feed like shrimp meal (SM), synthetic amino acids (SA), silkworm pupae (SWP) and silkworm moth (SWM) were prepared iso-nitrogenous with 44.44% (± 0.5) protein. 12 cages (0.5 m³) were installed in a raceway pond (8 m x 1.25 m x 0.9 m) in three replications for each diet in RBD. Five hundred fry were stocked in each cage with the regular inflow of water. The feed was given 8 to 10 times a day to satiation. Prior to study work, fry were kept starved for 24 hour and feed was given at a required percentage of body weight. After two week interval, fifty fry from each cage were randomly collected for weight and length measurement. One way Analysis of Variance, ANOVA was applied using Tukey Multiple range test in SPSS software to evaluate growth response on different protein source feed at 95 % confident level.

Table 1. Composition and proximate analysis of experimental diets (g/100g diet).

Ingredients	Diet-1	Diet-2	Diet- 3	Diet- 4
	SM ^a	SAA ^b	SPM ^c	SMM ^d
Big Shrimp	50	-	-	-
Lysine+Meth	-	30+10	-	--
Silkworm pupae	-	-	50	-
Silkworm moth	-	-	-	50
Soybean powder	35	35	35	35
Wheat powder	15	25	15	15
Vitamin pemix	1	1	1	1
Mineral premix	1	1	1	1
Vitamin-c	0.1	0.1	0.1	0.1
<i>Proximate composition</i>				
Moisture	8.97	11.54	10.35	3.66
Ash	11.67	5.06	5.65	7.13
Crude fats	8.62	6.48	17.01	20.85
Crude protein	38.27	48.47	42.68	46.01
Crude fiber	2.65	1.86	2.8	3.11

^aSM = shrimp meal, ^bSAA = synthetic amino acids, ^cSPM = silkworm pupae, ^dSMM = silkworm moth.

Source: Fisheries Research Division, Godawari

Results and Discussion

The final weight of fry was found significantly different fed with four different diets. Growth was highest with 2.34 g mean weight per fry in silkworm pupae feed. Highest specific growth rate (SGR) was recorded in silkworm pupae (1.26) followed by shrimp meal (1.11) and silkworm moth (0.99). But the lowest specific growth rate was recorded in synthetic amino acid (0.41). SGR was recorded significantly different in all the test protein diets ($p < 0.05$) (Table 2).

Table 2. Mean initial body weight, weight gain, FCR, SGR and survival of *O. mykiss* fry fed test diets containing different protein sources for 8 weeks.

	Diet			
	SM	SAA	SPM	SMM
Mean Initial Weight (g/fish)	0.32 ^a	0.28 ^a	0.29 ^a	0.34 ^a
Mean Final Weight (g/fish)	2.02 ^a	0.55 ^b	2.34 ^c	1.76 ^d
SGR	1.11 ^a	0.41 ^b	1.26 ^c	0.99 ^d
FCR	1.46 ^a	3.75 ^a	1.33 ^a	2.46 ^a
Survival (%)	96 ^a	23 ^b	85 ^a	84 ^a

*Values in a same row having the different superscript are significantly different ($p < 0.05$; Tukey multiple range test).

Mean FCR was recorded 1.46, 3.75, 1.33 and 2.46 for shrimp meal, synthetic amino acid, silkworm pupae and silkworm moth respectively (Table 2). The lowest FCR value was found for silk worm pupae. Rangacharyullu et al. (2003) also reported lower FCR (2.1) and higher SGR (2.39) in silk worm pupae compared to fish meal with FCR (3.16) and SGR (2.2). Silkworm meal showed also good growth and feed conversion in carps (Jeyachandran and Raj 1976; Erencin, 1976; Borthakur et al. 1998; Nandeeshha et al. 1990). The highest survival (96%) was found in shrimp meal and lowest (23%) in synthetic amino acids (Table 2). Survival rate was found lower in silkworm pupae meal (85%) than that of shrimp meal (96%) in present study. This might be due to some experimental error, as Rangacharyullu *et al.* (2003) reported better survival rate in silkworm pupae (84.2%) compared to fish meal (67.5%). High mortality and poor growth was recorded in SAA (diet 2). Reduced growth and high mortality was reported at 30% lysine and 10% methionine (Yvonne et al. 1957). According to Yvonne et al. excess lysine was responsible for lysine toxicity with poor growth and feed utilization. The normal quantity of methionine should be around 1.0-2.35% in rainbow trout (Walton et al. 1982).

Conclusion

FCR and SGR were found highest in silkworm pupae among four diets. The synthetic feed like methionine and lysine supplemented with plant protein (diet 2) revealed poor growth and survival rate. Hence, silkworm pupae meal can be used as alternate to replace shrimp meal in trout feed.

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