# REPLACEMENT OF FISH MEAL WITH SUPPLEMENTATION OF SILKWORM (*BOMBYX MORI*) PUPAE MEAL ON GROWTH IN COMMON CARP.

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*Abstract :* An experiment was conducted to determine the effect of replacement of fishmeal with silkworm (*Bombyx mori*) pupae meal (SWP) on growth and feed utilization of Common carp. six serious of diets of silkworm pupae meal about 40% crude protein with varying levels of replacement of fish meal SP0,SP1,SP2,SP3,SP4 and SP5(0,10,20,30,40 and 50%) were provided at 40 % live fish body weight for 60 days. The growth and feed utilization parameters was higher in fingerlings fed the diets with mixed fishmeal and SWP (the highest was 40%) and lower in those fed 0% of SWP or fishmeal. Significant differences were reported for growth, when increasing silkworm pupae meal diet increasing weight gain, feed intake, specific growth rate FCR also decrease.40% SWP suitable for fish growth in aquaculture.

*Keywords:* weight gain, feed intake, specific growth rate, feed conversion rate, silkworm pupa meal,

**INTRODUCTION**

Aquaculture is the fastest growing sector of world human food production and has an annual increase of about 10% (FAO, 1997). A relatively new approach is the use of insects as a source of animal protein in fish nutrition (Bondari and Sheppard, 1981). Stressed that, insects in various development stages have been used to feed fish and farm animals. (Hickling, 1962) noted that silkworm pupae have been an important component of carp diet in Japan and China (Newton *et al.*, 1977). Therefore efficient feed formulation should be made by utilizing the knowledge on the nutritional requirements and availability of local feed ingredients, diet palatability acceptability and digestibility capacity of fish. Make the feed economical, reduce the costs of fish production as well as increase the total yields of fish in semi-intensive and intensively managed ponds. The objective of aquaculture is to maximize survival and growth of cultured organism at minimal cost. For maximize fish production nutritional requirements of culture species have to be satisfied (Subha Rao, 2000). Food quality and quantity affect the growth rate of fish (James *et al.*, 1993). Therefore, many experiments have been carried out by different authors on the qualitative and quantitative nutritional requirements of fish. Therefore there is need to the incorporate unexplored unconventional locally available cheaper feedstuffs in fish feeds. Silkworm pupae meal derived from reeled silk is a suitable candidate for a fishmeal replacement because of its high nutritional value and abundance in China. Dry pupae contains 50-70% crude protein and 24-33% crude lipid and as a high quality insect protein source with a rich and balanced content of essential amino acids. Its nutritional value is comparable with that of fishmeal but the price is much lower.

**MATERIALS AND MATHODS**

In the present study the experimental was conducted for 60 days to study, the effect of six different levels of silkworm pupae SP0, SP1, SP2, SP3, SP4 and SP5 (0, 10, 20, 30, 40 and 50%) on growth in *Labeo rohita*. Well acclimated *Labeo rohita* were selected from the stock and divided in to six groups of its individual each triplicate were maintained for each group. They were not fed for 24 hours before commencement of the experiment. Growth parameters such as weight gain Feed conversion ratio (FCR) Specific Growth Rate (SGR) Feeding rate (FR) Growth rate, Weight of gain and Feed intake were calculated as follows.

Weight gain = Final body weight – Initial body weight

$$\text{Mean body weight (g)} = \frac{\text{Wet weight of fish (g)}}{\text{No. of fish in the aquarium}}$$

$$Rate\ of\ feeding\ = \frac{Food\ consumed\ (C)(mg)}{Initial\ \text{wet weight of fish}\ (g) \times Number\ of\ days}$$

$$Feed\ conversionratio\,(FCR) = \frac{Feed\ consumed\,(g)}{Wet\ weight\ gained\,(g)}$$

$$\text{Specific growth rate (SGR)} = \frac{\text{Final wet weight} - \text{Initial wet weight}}{\text{Duration days (t)}} \times 100$$

**RESULTS**

An increase in the supplementation of silkworm pupae meal in fish increased the mean body weight and length in *L. rohita* (Table. 1 Fig. 1). An increase in the supplementation of silkworm pupae meal in fish increased the weight gain and feed intake in *L. rohita*. Weight gain of *L. rohita* consumed control diet 7.15 increased to 9.90, 10.15, 12.35, 17.70 and 16.15 mg $g^{-1}$ live fish $day^{-1}$. 40% silkworm pupae diet hold a significant and positive correlation (r = 0.9956; P< 0.01) was obtained between the silkworm pupae levels and weight gain in *L.rohita*. For instance, feed intake of *L. rohita* consumed fishmeal diet control 35.05 increased to 35.47, 36.30, 36.49, 45.34 and 41.23 mg $g^{-1}$ live fish $day^{-1}$ in the fish consumed 0, 10, 20, 30, 40 and 50% (SP0, SP1, SP2, SP3 and SP4) (Table. 1; Fig. 2). However *L.rohita* fed 10% SWP meal exhibited maximum feeding rate and there after it increased with an increasing of SWP diets. For instance feeding rate of *L.rohita* fed with 10% SWP diet was 107 mg $g^{-1}$ live fish $day^{-1}$ and declined to 106.03 and to increase 108.89, 115.40, 134.70 and 131.05 mg $g^{-1}$ live fish $day^{-1}$ in fish fed with fishmeal diet alone 30% SWP diet respectively 40% SWP respective showed that greater than 30% and 50% diets. The feeding rate and silkworm pupae levels hold significant correlation (r = 0.961; P < 0.01) between them. Two way ANOVA test revealed that feeding rate levels hold significant (P<0.01) between silkworm pupae level and rearing period of experiment (Table.1).

The specific growth rate (SGR) of *L.rohita* increased with the increasing levels of SWP. For instance, *L.rohita* fed on SWP 0% respectively 7.25 and 8.36, 8.95, 10.25, 12.65 and 19.44 (Fig. 3). Analysis of variance showed significant influence of such factor as difference in diet (level of fishmeal replacement) to such parameters as weight gain, relative growth rate, food conversion ratio and protein efficiency ratio which were significantly different (p < 0.01) Feed conversion ratio (FCR) value was low. The feed conversion ratio of *L.rohita* was gradually decreased 4.89, 3.58, 3.42, 2.84, 2.56 and 2.80 FCR value in relation to SWP diets elicited the lower value of FCR as compared to other diets. The feeding rate and silkworm pupa levels hold significant correlation (r = 0.562; P < 0.01) between them (Fig. 4).

**Table.1 Effect of partial replacement of fishmeal with silkworm pupae meal diet on selected feed utilization parameters in *Labeo rohita* reared for 60 days. Each value is the mean ($\bar{X}$±SD) of three estimations.**

| Rearing period (Days) | SP0 | SP1 | SP2 | SP3 | SP4 | SP5 |
|---|---|---|---|---|---|---|
| **Mean body weight (g wet wt)** | | | | | | |
| 0 | 16.26±1.23 | 16.73±1.28 | 16.22±1.12 | 15.81±2.25 | 16.83±2.56 | 15.73±1.75 |
| 20 | 17.31±1.72 | 17.74±1.44 | 17.22±2.32 | 17.27±2.74 | 18.83±2.35 | 17.55±1.28 |
| 40 | 19.53±3.25 | 18.34±3.45 | 19.47±4.23 | 19.53±4.54 | 20.82±3.52 | 19.96±3.54 |
| 60 | 20.62±1.24 | 20.32±1.32 | 21.45±2.54 | 21.96±3.52 | 23.85±1.12 | 22.48±2.16 |
| **Mean body length (cm)** | | | | | | |
| 0 | 5.26±1.25 | 5.73±1.74 | 5.41±2.54 | 5.51±2.32 | 5.76±2.42 | 5.52±2.46 |
| 20 | 6.16±1.74 | 6.26±1.82 | 6.43±2.28 | 6.26±1.20 | 6.83±1.34 | 6.43±1.28 |
| 40 | 6.53±1.28 | 6.60±2.16 | 6.76±3.12 | 6.66±3.23 | 7.02±2.12 | 6.58±3.12 |
| 60 | 6.56±1.74 | 6.56±2.28 | 7.97±2.29 | 7.66±1.46 | 8.33±2.28 | 7.23±2.46 |
| **Weight gain (g wet weight)** | | | | | | |
| 20 | 5.02±0.45 | 5.05±0.24 | 6.13±0.16 | 7.48±0.36 | 9.60±0.72 | 9.25±0.76 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 40 | 6.25±0.72 | 7.82±0.36 | 8.50±0.24 | 8.15±0.45 | 10.6±0.32 | 9.35±0.36 |
| 60 | 7.15±0.42 | 9.90±0.26 | 10.15±0.54 | 12.35±0.62 | 17.70±0.21 | 16.15±0.16 |
| **Feed intake (g dry weight)** | | | | | | |
| 20 | 33.35±1.75 | 33.50±2.52 | 35.21±3.46 | 35.68±2.41 | 35.68±2.16 | 35.21±2.25 |
| 40 | 34.14±3.52 | 34.58±4.25 | 34.67±5.43 | 35.55±5.23 | 38.83±3.46 | 35.58±3.24 |
| 60 | 35.08±2.46 | 35.47±6.46 | 36.30±7.52 | 36.49±3.44 | 45.34±3.15 | 41.23±4.12 |
| **Feeding rate (mg $g^{-1}$ live fish $day^{-1}$)** | | | | | | |
| 20 | 102.55±1.24 | 100.14±1.36 | 108.53±2.32 | 112.83±2.38 | 106.00±1.84 | 111.19±2.76 |
| 40 | 104.98±2.35 | 103.37±3.24 | 106.87±4.23 | 112.43±5.43 | 115.35±4.32 | 113.09±4.25 |
| 60 | 107.87±1.57 | 106.03±1.84 | 108.89±1.76 | 115.40±2.36 | 134.70±2.13 | 131.05±2.18 |
| **Specific growth rate (SGR)** | | | | | | |
| 20 | 4.70±1.14 | 6.15±2.17 | 6.55±3.16 | 6.75±2.41 | 6.85±3.52 | 6.24±3.18 |
| 40 | 6.20±2.08 | 6.45±2.36 | 7.83±2.36 | 8.63±3.18 | 10.70±2.14 | 8.63±1.25 |
| 60 | 7.25±2.26 | 8.36±2.42 | 8.95±3.29 | 10.25±3.24 | 12.65±2.16 | 9.44±2.38 |
| **Feed conversion ratio (FCR)** | | | | | | |
| 20 | 6.72±2.42 | 6.43±3.25 | 5.67±2.42 | 4.77±1.98 | 3.43±2.14 | 3.80±3.12 |
| 40 | 5.50±2.28 | 4.42±2.32 | 4.33±3.54 | 4.80±3.43 | 3.66±1.78 | 3.91±2.19 |
| 60 | 4.89±1.73 | 3.58±1.24 | 3.42±2.32 | 2.84±2.34 | 2.56±2.62 | 2.80±2.16 |

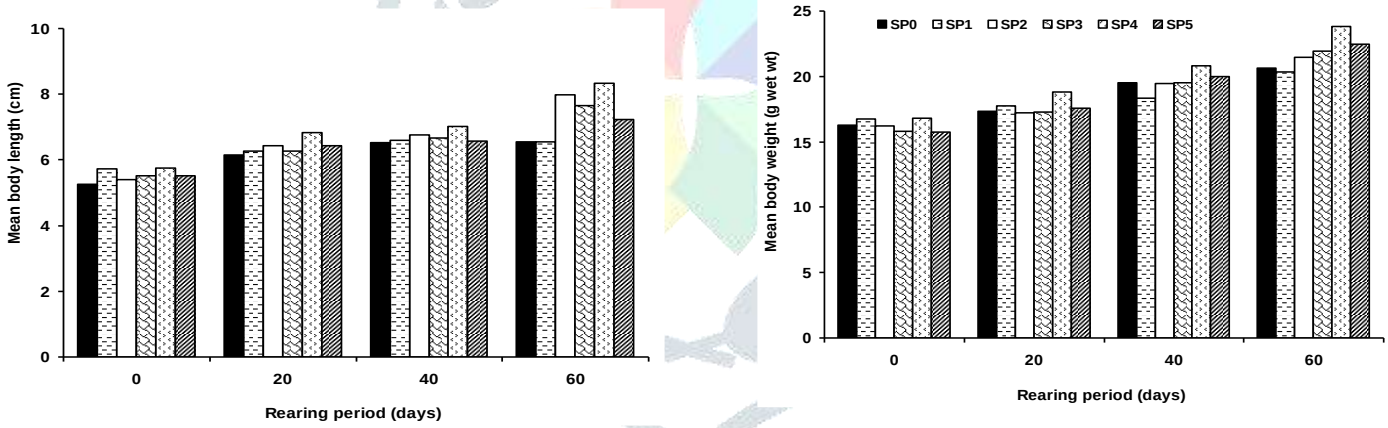


**Fig. 1 Effect of partial replacement of fishmeal with silkworm pupae meal diet on mean body weight and length of fish in *Labeo rohita* reared for 60 days. * P < 0.01**

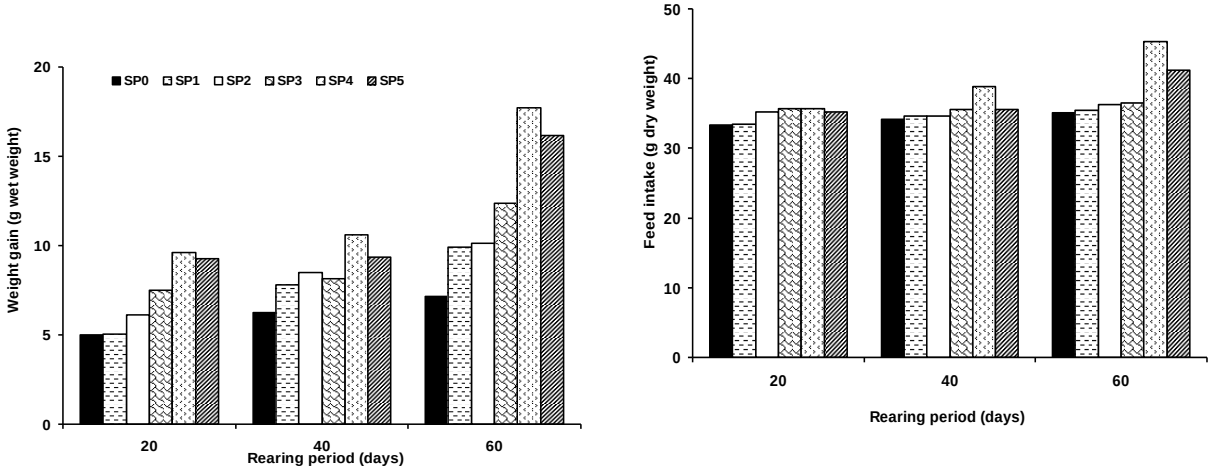

**Fig. 2 Effect of partial replacement of fishmeal with silkworm pupae meal diet on weight gain and feed intake of fish in *Labeo rohita* reared for 60 days. *P <0.01; NS : Non-significant**

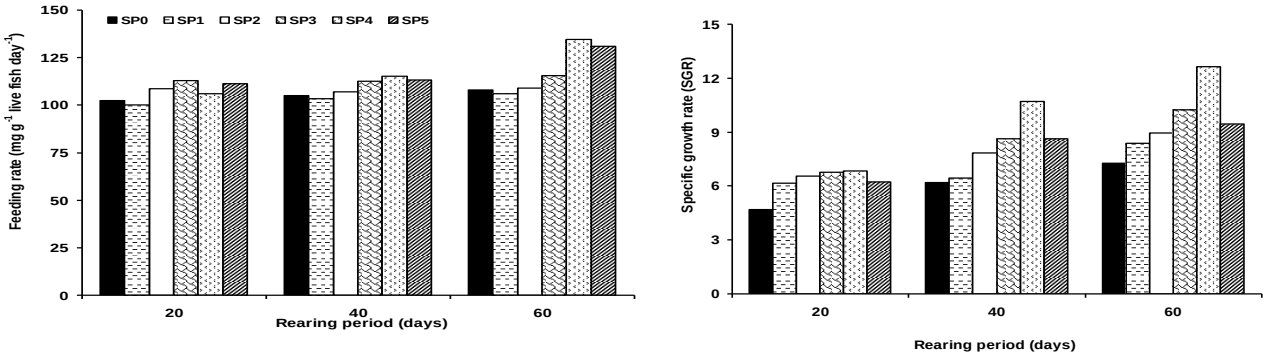


**Fig.3: Effect of partial replacement of fishmeal with silkworm pupae meal diet on feeding rate and specific growth rate of fish in *Labeo rohita* reared for 60 days.**

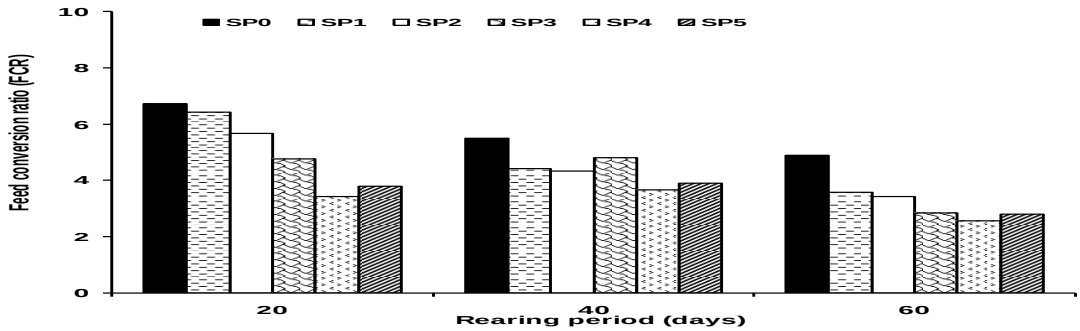


**Fig.4: Effect of partial replacement of fishmeal with silkworm pupae meal diet on feed conversion ratio of fish in *Labeo rohita* reared for 60 days.**

## DISCUSSION

Results shows that indicate the growth performance of *Labeo rohita* significantly increased when fed with different levels of silkworm pupae meal incorporated diet. The final body weight, FCR, SGR, FR and GCE of *Labeo rohita* improved significantly with increasing silkworm pupae meal fed diet up to 50% Increasing silkworm pupae meal level beyond 40% had no significant effects on growth. Silkworm pupae contains high protein source and many essential amino acids, vitamin and minerals in large quantities studies on 30% silkworm pupae supplementation increase growth rate with common carp Nandeesha *et al*., (1990). Catla and rohu Begun *et al.*, (1994) found that significantly better specific growth rate, food conversion ratio in rohu fed with a 50% silkworm pupae diet compared to fishmeal diet silkworm pupae are the traditional food used many years ago as a stable diet for koi in Japan. Jeya Chandran and Paulraj (1976) observed improved growth of common carp by feeding it with silkworm pupae, a pellet containing prawn waste, fishmeal and tapiaco flour. Jayaram and Shetty (1980) evaluated the usefulness of silkworm pupae in the diet of catla and rohu common carp at 30% incorporation. Brothkur (1983) studied the possibility of combining silkworm pupae with shrimp waste or clam meat in the diet of silver carp, mrigal and rohu.

Shyma (1990) reported that complete replacement of fishmeal with raw silkworm pupae (75% incorporation at 60% level induced the best growth. Similarly inclusion of 50% de-oiled silkworm pupae in a diet devoid of fishmeal resulted in better growth of mahseer. Shashi *et al.* (2014), Venkatramaiah *et al.* (1975) found that artificial feed containing animal protein can be induced in the feed formulation of fry common carp for better growth. Mathew and Jayaprakash (1993) found that, the feed containing 45% protein gave the maximum growth rates and the survival rates. Nazareth Nisha *et al.* (2014) reported the efficiency silkworm pupae meal incorporated diet. The final body weight, FCR, SGR, FR and GCE of *M. estherae* improved significantly with increasing silkworm pupae meal fed diet up to 60%. Increasing silkworm pupae meal level beyond 60% had no significant effects on growth. Similarly Hossain *et al.*, (1993) stated that silkworm pupae meal could be used as a substitute for fishmeal at up to 75% of protein in Asian Olaniyi and Babasanmi (2013) suggested that, the 100% silkworm pupae meal (*Anaphe infracta*) diet enhances better growth performance in African cat fish. In the present study the growth rate at different protein levels showed

that at 40% level and 40 levels the maximum growth was obtained and 0 - 60 days difference was observed in the growth of the common carp.

**CONCLUSION**

The former might be attributed to the insufficient protein for optimum amino acid synthesis to bring about maximum growth. The present study, among the experimental diets silkworm pupae meal diet was observed as a more quickly acceptable feed, compared to other feeds. It indicated that it was better incorporate silkworm pupae meal in to common carp feed to serve as an attractant and also for setting better growth parameter.

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