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Growth performance and body composition of rohu, *Labeo rohita* fed organic selenium supplemented diets

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Abstract
Eight weeks feeding trial was conducted to evaluate the effect of dietary organic selenium (OS) on growth, survival and body composition of rohu (*Labeo rohita*). The organic selenium (OS) was supplemented at 0, 1, 2 and 3 g/kg diet. The test diets were fed for 8 weeks in triplicate groups of rohu, which had initial weight of 1.2 g. At the end of the feeding trial, growth and survival of rohu was recorded. Fish fed with OS incorporated diets had no significant differences on growth parameters as well as body composition parameters.

Keywords: Organic selenium (OS), *Labeo rohita*, growth, survival, body composition.

1. Introduction
Selenium (Se) is one trace mineral which has recently received a considerable amount of attention in animal nutrition. It is a component of the enzyme glutathione peroxidase (GPx, EC 1.11.1.9) (Rotruck *et al*., 1973) [17]. This enzyme catalyzes reactions necessary for the conversion of hydrogen peroxide and fatty acid into water and fatty acid alcohol by using reduced glutathione, thereby protecting cell membranes against oxidative damage. Organic Se (selenomethionine) has been reported to have higher bioavailability than the inorganic Se (sodium selenite) for Atlantic salmon (Bell and Cowey, 1989; Lorentzen *et al*., 1994) [3, 14] and channel catfish (Wang and Lovell, 1997) [19].
The present study was carried out to evaluate the effect of organic selenium on growth, survival and body compositon of *Labeo rohita* fed with different levels of organic selenium (OS) supplemented diets.

2. Materials and methods
2.1 Experimental Procedure
Labeo rohita with an average weight of 1.2 g produced in the carp hatchery at the College of Fisheries, Mangalore, India were used for the study. All the fingerlings were acclimatized by feeding control diet for two weeks. Three hundred rohu fingerlings were randomly distributed into four groups. Four experimental groups, namely, control (T_0) (basal diet with no OS), T_1 (1 gkg^{-1} OS), T_2 (2 gkg^{-1} OS) and T_3 (3 gkg^{-1} OS) were arranged in triplicate groups following a completely randomized design (CRD) design and fed respective diets. The total volume of water in each tank was maintained at 100 l throughout the experimental period. Fish were fed with one of the four experimental diets at a feeding rate of 4% of body weight per day for eight weeks. The amount of feed for each tank was divided to two equal meals, which were offered to fish at 10:00 and 17:00 h. Fish in each tank were collected, counted and weighed at 2-week intervals, and the offered diets were subsequently readjusted. Three quarters of tank's water volume along with fish excreta was removed daily by siphoning and replaced with an equal volume of well-aerated freshwater. Dead fish if any were removed and recorded. At the end of the experiment, fish were collected from each tank, counted, and group-weighed.

2.2 Analysis of physicochemical parameters of water
Water quality parameters were maintained within the normal range throughout the experimental period. Water samples collected on each sampling day were analyzed for pH, temperature, dissolved oxygen, free carbon dioxide, ammonia and total alkalinity. Digital portable kit model CK 704 was used to record pH, atmospheric temperature and water temperature. Dissolved oxygen was estimated by Winkler's method. Total alkalinity, ammonia and free carbon dioxide were determined by following Standard methods (APHA, 1995) [2].

In all treatments, dissolved oxygen concentrations ranged from 6.9 to 7.43 mgL^{-1}, free CO_2 ranged from 1.39 to 3.05 mgL^{-1}. The ambient water temperature range was 26.5 ºC to 27 ºC. The pH range was 7.12 to 7.67. Free carbon dioxide, and unionized ammonia concentration ranged from 0.99 to 2.82 mgL^{-1} and 0.040 to 0.347 mgL^{-1} respectively. Total alkalinity ranged from 61.8 to 80.23 mgL^{-1} as $CaCO_3$. All the water quality parameters were within the acceptable ranges for growth (Boyd, 1982) [5].

2.3 Experimental diet

The composition of experiment diet is given in Table 1. Soyabean meal and groundnut cake were used as protein sources and rice bran and tapioca flour were used as carbohydrate sources. Graded levels of dietary organic selenium (OS) were added to the respective diet (Table 1). Dry and powdered ingredients were thoroughly mixed and mixed with water to make soft dough. The dough was steam cooked for 10–15 minutes in a pressure cooker. Vitamin-mineral premix was added and thoroughly mixed with diets after cooling and diets were extruded through a laboratory pelletizer having 2 mm dia. Pellets were dried in hot air oven at 60°C till the moisture content was reduced to less than 10%. Diets were packed in high-density polythene bags and stored in refrigerator.

Table 1: Composition and proximate analyses (% on dry matter bases) of the experimental diets containing different levels of organic Selenium

Treatment				
Ingredient	**T_0**	**T_1**	**T_2**	**T_3**
Soyabean meal	47.95	47.95	47.95	47.95
Ground nut oil cake	20.0	20.0	20.0	20.0
Rice bran	26.05	25.95	25.85	25.75
Tapioca flour	5.0	5.0	5.0	5.0
Vitamin and mineral mixture	1.0	1.0	1.0	1.0
Organic selenium	0.0	0.1	0.2	0.3
Total	100	100	100	100
Proximate composition of diets (%)				
Moisture	8.65 ± 0.10	8.56±0.11	8.60±0.16	8.59±0.07
Dry matter	91.29±0.16	91.42±0.07	91.36±0.04	91.41±0.12
Protein	30.45±0.07	30.51±0.10	30.38±0.08	30.47±0.14
Fat	6.69±0.14	6.72±0.1	6.61±0.09	6.58±0.15
Fibre	9.17±0.13	9.28±0.04	9.21±0.07	9.14±0.11
Ash	8.89±0.08	8.92±0.17	8.85±0.15	8.96±0.06
NFE	36.15±0.21	36.01±0.23	36.35±0.14	36.26±0.10

2.4 Growth trial

Rohu were weighed at the beginning of the experiment and every 15 days interval thereafter till the completion of the experiment. The growth performance of rohu was assessed in terms of weight attained.

2.4.1 SGR

Specific growth rate was calculated by using the following formula

$$SGR = \frac{\text{In final weight (g)} - \text{In initial weight (g)}}{\text{No of days}} \times 100$$

The calculated value gives the average percentage increase in weight per day over the experimental period.

2.4.2 Food conversion ratio (FCR)

Food conversion ratio was calculated by using the following formula

$$FCR = \frac{\text{Dry weight of the feed given (g)}}{\text{Gain in wet weight of fish (g)}}$$

2.4.3 PER

Protein efficiency ratio was calculated by using the following formula

$$\text{Protein efficiency ratio PER} = \frac{\text{Weight gain (g)}}{\text{Protein intake (g)}}$$

2.4.4 Survival

Survival was calculated as the difference between the number of live animals stocked at the beginning and those survived at the end of the experiment.

2.5 Proximate analysis

Proximate composition of experimental diets before starting the experiment and fish muscle was estimated soon after completion of the experiment. Whole meat of the fish was taken for proximate analysis. The fish meat was minced thoroughly and dried at 60°C for 12 hours to obtain the dry matter. The dry matter thus obtained was powdered and stored in air tight containers for further analysis. The samples were analyzed for crude protein, crude fat, total ash and carbohydrate (NFE) employing standard methods.

2.6 Statistical analysis

The mean growth and survival of rohu were recorded and significant difference among them was tested by one way ANOVA test. When the ANOVA identified differences among groups, multiple comparisons among means were made with Duncan's new multiple range test. A statistical package SPSS version 20.0 was used for data analysis.

3. Results and Discussion

The final weight of rohu fed supplemental organic selenium was found to be greater than that of rohu fed the basal (control) diet. However, No significant (P=0.494) difference in growth was observed between rohu fed with OS diet (Table 2) and control. Survival over the 60 days feeding period was higher for rohu fed with 1 gkg^{-1} OS compared to other

treatment groups. Rohu had attained mean weight of 292.76% in T_1 group, which is 7.49 % higher growth than the groups fed control diet. Highest survival was recorded in T_1 (1g kg^{-1} OS) (P=0.125) (Table 2). No significant difference was observed in survival rate due to the inclusion of OS in fish diets. The survival of rohu ranged from 69.0 to 85.0%.

Table 2: Growth performance and survival (mean ± SD) of rohu fed different levels of organic selenium for 8 weeks

Items	OS levels (g/kg diet)			
	T_0	T_1	T_2	T_3
Final weight gain (g $fish^{-1}$)	3.42 [a]	3.51[a]	3.23 [a]	3.2 [a]
Weight gain (% of initial weight)	285.27 [a]	292.76 [a]	276.66 [a]	269.72 [a]
SGR (% day^{-1})	1.74[a]	1.77[a]	1.63 [a]	1.63[a]
Survival rate (%)	69 [a]	85[a]	66.66 [a]	70.66 [a]
FCR (g feed g $gain^{-1}$)	2.69[a]	2.25[a]	2.81[a]	2.65[a]
Protein efficiency ratio	1.42[a]	1.46[a]	1.42[a]	1.42[a]

Means with the same superscript in the same row are not significantly different at P<0.05.

No significant change in moisture content of flesh was observed among the different treatments (P=0.573) and it ranged from 77.69 to 78.19% (Table 3). Crude protein increased significantly (P=0.056), while total lipids decreased with the increase of OS level in fish diet (P=0.508.). The highest content of crude protein (15.16±0.09%) was found in F_1 fish group fed with 1g OS kg^{-1} diet, while the lowest crude protein level (14.45±0.35%) was seen in fed with 3g OS kg^{-1} group. The highest content of total lipid (2.47±0.09%) was found in the control group, while the lowest one (2.27±0.07%) was found in the fish group fed on 3g OS kg^{-1} diet, respectively. No significant difference (p=0.867) was observed in ash content among different treatments and it ranged from 2.05 to 2.11%.

Table 3: Proximate body composition of rohu fed with different levels of organic selenium for 8 weeks

Items	OS levels (g/kg diet)			
	T_0	T_1	T_2	T_3
Moisture (%)	78.09[a]	77.69 [a]	78.02 [a]	78.19 [a]
Dry matter (%)	21.90 [a]	22.30 [a]	21.98 [a]	21.81 [a]
Protein (%)	14.65 [ab]	15.16 [b]	14.74 [ab]	14.45 [a]
Fat (%)	2.47 [a]	2.33 [a]	2.30 [a]	2.27 [a]
Ash (%)	2.05 [a]	2.11 [a]	2.09 [a]	2.07 [a]
NFE (%)	2.75 [a]	2.73 [a]	2.84 [a]	3.0 [a]

Means with the same superscript in the same row are not significantly different at P<0.05

The main objective of the present investigation was to evaluate the efficiency of dietary organic selenium on growth, survival and proximate composition. In the present investigation, OS incorporated diets has effect on growth and survival of rohu although there was no significant difference among the treatments and control (Table. 2). The results are comparable with the published reports. Feeding trial conducted by Lin and Shiau (2005) [13] reported that grouper has a requirement for selenium which cannot be met in the unsupplemented diet, thus dietary supplementation is necessary. The highest weight gain was found in fish fed diet with 0.77mg Se/Kg. This along with the fact that growth was depressed significantly in fish fed diets supplemented with 2.02 mg Se/kg.

Selenium deficiency generally results in growth depression. Mortality noted in salmon fry fed a selenium-deficient diet was prevented by administration of a diet containing 0.1 mg Se kg^{-1} and 500 IU vitamin E kg-[1] (Poston *et al*., 1976) [16]. When Atlantic salmon were fed a selenium-deficient diet for 26 weeks, the deficiency signs recorded were lethargy, loss of appetite, reduced muscle tone and mortality. The best growth was achieved at a selenium level of 0.15 mg kg^{-1} (Poston and Combs, 1979) [15].

Selenium deficiency causes growth depression in rainbow trout (Hilton *et al.,* 1980) [11], carp (Satoh *et al*., 1983) [18] and catfish (Gatlin and Wilson, 1984) [8] but the selenium deprivation alone does not produce any pathological sign in these fish. Glutathione peroxidase activity in plasma and liver decreases during selenium deficiency (Poston *et al*., 1976; Hilton *et al*., 1980; Bell *et al.,* 1985; Gatlin *et al*., 1986) [16, 11, 4, 9].

Selenium toxicity occurs in rainbow trout and catfish when the dietary selenium exceeds 13 and 15 mg kg^{-1} dry feed, respectively (Hilton *et al.,* 1980; Gatlin and Wilson, 1984) [11, 8]. Reduced growth, poor feed efficiency and high mortality are the major effects of se toxicity. Trout reared on high Se-diets (10mg/kg) also showed renal calcinosis. (Hilton and Hadson, 1983) [10].

Growth was improved by an increase in dietary Se in channel catfish (*Ictalurus punctatus*) (Gatlin and Wilson, 1984) [8], crucian carp (*Carassius auratus gibelio*; Zhou *et al*., 2009) [20] and rainbow trout (*Oncorhynchus mykiss*; Hunt *et al*., 2011) [12] but even the highest dietary Se concentration (4.42 mg/kg) did not have an impact on the growth of hybrid striped bass (Cotter *et al*., 2008) [6]. While a high Se concentration in diets did not have any impact on growth in carp but it caused significant Se accumulation in the kidney, liver, and muscles (Elia *et al*., 2011) [7]. Ahmad *et al.* (2006) [1] reported that with OS supplementation to Nile tilapia fry enhanced the growth and feed utilization.

In the present study, there was no significant difference in the final mean body weight and length in different treatments. FCR, PER, SGR were not showed any significant difference between treatments, better result has showed in 1g/kg OS inclusion diet. Higher survival was observed in F_1 (1g/kg OS). There was no significant difference (p>0.05) found in survival in all experimental groups after 60 days of culture period. Proximate analysis of the whole body of rohu at the end of the feeding trial indicated a decline in lipid content of fish fed with 1 g OS kg^{-1}. There was an inverse relationship observed between total protein and lipid contents. Moisture and ash contents did not vary much.

4. Conclusion

Based on the results of the present investigation, it is concluded that the inclusion of OS in rohu diets has no significant difference on growth, survival and proximate composition although inclusion of 1 g kg^{-1} OS was found better than other treatments as well as control.

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