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Effect of Selenium on Various Growth Parameters in The Fingerling of Cirrhinus Mrigala

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Abstract

Selenium is an essential element for the fish growth. Experiment for a period of 45 days were conducted for the fingerlings of cirrhinus mrigala with different levels of selenium i.e. 0.00 (control), 0.01, 0.02, 0.04, 0.08, 0.16, 0.32 and 0.64 mg/kg and purified diet. The maximum weight gains Specific Growth Rate (SGR), Gross Conversion Efficiency (GCE) and food conversion efficiency were noted with the lower FCR of the fingerlings at a dietary levels of 0.32 mg se/kg of purified diet. The selenium supplemented purified diets were also found useful in growth of cirrhinus mrigala fingerlings.

Key Words: Selenium; cirrhinus mrigala fingerlings; SGR; GCE; FCR; LS; DS; PLE and PLE.

Introduction:

Millions of human beings suffer due to hunger and malnutrition and fish form a rich source of food, providing a means to tide over the nutritional difficulties. In addition to proteins, fat, carbohydrate, vitamin and minerals are also required in small amount for the proper functioning of body to prevent the deficiency disease and better fish production. Fish has the ability to absorb required mineral from the surrounding water as were as from the diet. The recent year Se has received a considerable attention in animal as well as in fish nutrition. The optimum Se levels to be added in the diets may be helpful for growth, survival in the fingerlings of cirrhinus mrigala.

The water, levels of required minerals for the fishes may be poor with are necessitated either through fertilization of water or by mineral supplementation in fish diets. The latter is more practical and suitable, when fish are cultured in closed system. Those minerals essential to fulfill the nutritional requirements of higher animal, are also considered essential for fish. Fishes generally require a certain amount of mineral mixture in practical diets for optimize growth. However, response to mineral mixture supplemented in purified test diets is species specific for the fish.

Selenium is most abundant in the animal body and mainly concentrate in skeletal tissues. It is also an essential element for the fish growth. In aquatic environment fish can absorbed selenium through their gills, body surface and available food. It is established that dietary selenium increases the growth of certain fish species. The excessive waterborne selenium (100 µg 1^{-1}) is also reported acutely lethal to certain species of fish. Most vegetable and fruit contain 0.01 µg Se/g, and higher amount of Se are also present in other sea foods (0.3 - 0.7 µg Se/g), sea meat (0.15-2.00 µg Se/g) and grains (0.03-0.06 µg Se/g). Dietary requirements of selenium have determined for atlantic salmon (Salmo salar) Rainbow trout (Salmo gairdneri) using growth and biochemical parameters. Bell et al. 1987. The purpose of this study was to optimize the dietary requirement of selenium for the Indian Major Carp Cirrhinus mrigala fingerling. The nutritional requirements for fishes have been found to change with size, water qualities and per cent ingredients in the diet (Halver, 1972) investigated the macro and micronutrient requirement of fishes. Gatlin and Wilson (1984) suggested that growth of certain affected by dietary selenium level, and significant differences in weight grain were not easily desirable due to variability among the groups of fish. How much selenium is available from fish may have to be considered and imported when assessing selenium status of human being from the dietary intake.

Materials and methods:

The selenium as Na_2SeO_3 was used in the present study. Graded levels of selenium ranging from 0.0 to 0.64 mg/kg (Table 1.5) were added separately in the diet vermicelli (Figure 1.1)

Figure 1.1: Showing the vermicelli of practical and purified diets used in the feeding experiments.

were air dried and refrigerated. The ingredients used in the practical diet (Table 1.1). The details of vitamin and minerals premix used to the practical diet was illustrated in tables 1.2 and 1.3. The purified diet was used to determine the optimum requirement of selenium for the fingerlings of cirrhinus mrigala in respect to growth (Table 1.1).

S.No.	Ingredients	Per cent
1.	Casein (vitamin free)	25.10
2.	Gelatin	6.00
3.	White dextrin	32.40
4.	Cellulose	16.50
5	Cod liver oil	9.00
6.	Vitamin mixture[1]	3.00
7.	ADEK mixture[2]	1.00
8.	Selenium free mineral mixture[3]	4.00
9.	Carboxyl methyl cellulose	2.00
10.	Calcium carbonate	1.00
11.	Selenium levels[4]	-

1. Vitamin mixture - see table 1.2
2. ADEK mixture - see table 1.4
3. Selenium free mineral mixture - see table 1.3
4. Selenium levels - see table 1.5

Table 1.1: Per cent ingredients of the purified diet used for Se requirement of the mrigal fingerlings.

S.No.	Vitamin Ingredients	IU, mg/kg diet
1.	Calcium D—pantothenate	141 mg
2.	Pyridoxin HCl	41 mg
3.	Riboflavin	111 mg
4.	Niacin amide	293 mg
5	Folic acid	17 mg
6.	Thiamin	57 mg
7.	Biotine	0.79 mg
8.	Vitamin B_{12}	0.08 mg
9.	Menadione sodium bisuiphate	15 mg
10.	α— tocopherol acetate	668 mg
11.	Vitamin P acetate	8800 IU
12.	Myoinositol	352 mg
13.	Ascorbic acid	118.8 mg
14.	Vitamin D_3	660 IU

Table 1.2: Composition of vitamin mixture used in the purified diet

S.No.	Mineral Ingredients	mg, g/100g
1.	Calcium phosphate (mono basic)	13.58 g
2.	Calcium lactate	32.70 g
3.	Ferric citrate	2.96 g
4.	Magnesium sulphate hepta hydrate	13.20 g
5	Potassium phosphate dibasic anhydrous	23.98 g
6.	Sodium phosphate mono basic	8.72 g
7.	Sodium chloride	4.34 g
8.	Aluminium sulphate anhydrous	15.00 mg
9.	Potassium iodied	15.00 mg
10.	Cuprous chloride	10.00 mg
11.	Manganous sulphate	80.00 mg
12.	Cobalt chloride	100.00 mg
13.	Zinc sulphate hepta hydrate	300.00 mg
14.	Selenium	Nil

Table 1.3: Composition of selenium free mineral mixture used in the purified diet.

S.No.	Ingredients	g/kg dry diet
1.	Retinyl acetate (vit.A)	1.80
2.	Cholecalciferol (vit.D)	0.25
3.	DL - α - tocopherol (vit.E)	6.00
4.	Menodione (vit.K)	5.00

Table 1.4: Composition of ADEK mixture, i.e. fat-soluble vitamins used in the purified diet.

S.No.	Selenium (mg/kg diet)
1.	0.00 (Control)
2.	0.01
3.	0.02
4.	0.04
5.	0.08
6.	0.16
7.	0.32
8.	0.64

* as Na_2SeO_3

Table 1.5: Level of selenium* tried in the feeding experiment for dietary requirement of mrigal fingerlings.

The contents were mixed thoroughly and added 10% distilled water to prepare a thick paste. Vermicelli of diameter 1 mm size were made from the paste.

The healthy and same age groups of fingerlings were selected and acclimatized in cement cistern of 185 litre capacity for a period of 15 days (Figure 1.2).

Figure 1.2: Showing the experimental unit consisting cement cisterns of 185 lit. capacity

The experimental cisterns were labeled for selenium treatments and placed in shed to prevent algal growth from the sun light and then covered by nylon mesh (Figure 1.3).

Figure 1.3: Providing the nutritional conditions during the feeding experiments.

The weight vermicelli was dispersed in each cistern between 8 to 9 AM. The growth parameters i.e. weight gain, specific growth rate (GR), grows conversion efficiency (GCE) and food conversion ratio (FCR) were computed for the fingerlings fed selenium supplemented purified diets.

The ration given to the fingerlings was at the rate of 2 per cent of their total body weight. To avoid metabolic wastes in cistern, water was renewed twice a week, between 2.00 to 4.00 pm by siphoning. During feeding trials water temperature was ranging between 25 to 30°C.Increase in body weight of the fingerlings in varying dietary levels of selenium was recorded fortnight, i.e. on 16th, 31st and 46th day of the experiment. Before weighing, the fingerlings were kept on fasting at least for a period of 24 hours. Data were computed for growth response and feed efficiency, i.e. SGR, FCR and GCE. The growth data were statistically processed for complete randomized design (CRD) as per the prescribed standard methods (Snedcor 1967).

Results and discussion:

The weight gain of C. mrigala fingerlings fed selenium supplemented purified diets have been summarized in (Table 1.6).

S.No.	Selenium (mg/kg diet)	Weight gains (g) in days				Net weight gains (g)
		0	16	31	46	
1.	0.00 Control	80	85	92	97	17
2.	0.01	76	82	89	91	15
3.	0.02	70	76	82	87	17
4.	0.04	86	92	98	104	18
5.	0.08	76	80	85	90	14
6.	0.16	80	90	97	100	20
7.	0.32	84	94	102	107	23
8.	0.64	78	83	88	92	14

* @ 2 % bwpd

Table 1.6: Weight gains of mrigal fingerlings fed on selenium (Se) supplemented purified diets for an experimental period of 45 days.

S.No.	Selenium (mg Se/kg diet)	Food offered (g) in each fortnight			Total food offered (g)
		0-15	16-30	31-45	
1.	0.00 Control	24.00	25.50	27.60	77.10
2.	0.01	28.80	24.60	26.70	74.10
3.	0.02	21.00	22.80	24.60	68.40
4.	0.04	25.80	27.60	29.40	82.80
5.	0.08	22.80	24.00	25.50	72.30
6.	0.16	19.80	22.80	24.90	67.50
7.	0.32	25.20	28.20	30.06	83.46
8.	0.64	23.40	24.90	26.40	74.70

* @ 2 % bwpd

Table 1.7: Selenium supplemented purified diets offered to fingerlings for a period of 45 days.

The highest weight gain of 23 per cent of fingerlings was observed at a dietary concentration of 0.32 mg Se/kg diet. In the present study weight gains efficiency for the mrigal fingerlings in relation to dietary Se levels were 0.32 > 0.16 > 0.04 > 0.007 > 0.027 > 0.01 > 0.08 > 0.064 mg Se/kg purified diet.

SGR's of mrigal fingerlings with Se supplemented diets have been presented in (table 1.8.) The values of SGR were processed for analysis of variance (ANOVA Table 1.9).

S.No.	Selenium (mg Se/kg diet)	SGR (g) in each fortnight			Average SGR (g) for 45 days
		0.15	16-30	31-45	
1.	0.00 Control	0.333	0.467	0.333	0.378
2.	0.01	0.400	0.467	0.133	0.333
3.	0.02	0.400	0.400	0.333	0.378
4.	0.04	0.400	0.400	0.400	0.400
5.	0.08	0.267	0.333	0.333	0.311
6.	0.16	0.667	0.467	0.200	0.445
7.	0.32	0.667	0.533	0.333	0.511
8.	0.64	0.333	0.333	0.267	0.311

SGR for each fortnight SGR for 45 days

SEm + 0.017804 SEm + 0.010279

CD (5%) 0.051 CD (5%) 0.029

CD (1%) 0.067 CD (1%) 0.039

Table 1.8: Specific growth rate (SGR) of fingerlings fed on selenium supplemented purified diets for a period of 45 days.

S.No.	Source	df	ss	ms	F
1.	0.00 Control	2	0.035912	0.017956	18.89**
2.	0.01	2	0.187334	0.093667	98.53**
3.	0.02	2	0.008978	0.004489	4.72*
4.	0.04	2	0	0	< 1 N.S.
5.	0.08	2	0.008712	0.004356	4.58*
6.	0.16	2	0.329378	0.164689	173.24**
7.	0.32	2	0.169512	0.084756	89.16**
8.	0.64	2	0.008712	0.04356	4.58*
9.	between level	7	0.300301	0.042900	45.13**
10.	E (error)	48	0.045630	0.000951	
	TOTAL	71	1.094469		

CV = 8.046

** Significant at 1%

* Significant at 5%

NS Non-significant

Table 1.9: Analysis of variance (ANOVA) for SGR of mrigal fingerlings fed selenium supplemented purified diets.

The average highest values of SGR of 0.511 and 0.445 g/day of fingerlings at levels of 0.32 and 0.16 mg Se/kg diet were statistically significant at 1% levels. The significant values of SGR on these dietary Se levels is due to positive growth of mrigal fingerlings.

The gross conversion efficiency in the present study was also determined by total amount of food for each Se levels offered to fingerling (Table 1.7) and their weight increment (Table 1.5). The values of GCE for the mrigal fingerlings fed varying Se supplemented purified diet have been summarized in (table 1.10). The GCE's were also statistically analysed for the analysis of variance (ANOVA, Table 1.11).

S.No.	Selenium (mg Se/kg diet)	Fortnightly gross conversion efficiency GCE in each fortnight			Average GCE (g) for 45 days
		0.16	16-31	31-46	
1.	0.00 Control	0.208	0.274	0.181	0.221
2.	0.01	0.263	0.284	0.070	0.206
3.	0.02	0.285	0.263	0.203	0.250
4.	0.04	0.232	0.217	0.204	0.218
5.	0.08	0.175	0.208	0.196	0.193
6.	0.16	0.433	0.259	0.111	0.268
7.	0.32	0.396	0.283	0.167	0.281
8.	0.64	0.231	0.200	0.151	0.188

GCE for each fortnight GCE for 45 days

SEm ± 0.0130

SEm ± 0.075

CD (5%) 0.037 CD (5%) 0.021

CD (1%) 0.049 CD (1%) 0.028

Table 1.10: Gross conversion efficiency (GCE) of fingerlings fed on selenium supplemented purified diets for a period of 45 days.

S.No.	Source	df	ss	ms	F
1.	0.00 Control	2	0.013734	0.006867	13.54**
2.	0.01	2	0.083486	0.041743	82.33**
3.	0.02	2	0.010808	0.005404	10.66**
4.	0.04	2	0.001178	0.005890	1.16 NS
5.	0.08	2	0.001674	0.000837	1.65 NS
6.	0.16	2	0.155864	0.077932	153.71**

7.	0.32	2	0.078666	0.039333	77.58**
8.	0.64	2	0.006414	0.003207	6.32**
9.	between level	7	0.076208	0.010887	21.47**
10.	E (error)	48		0.000507	
	TOTAL	71	0.45235		

CV = 9.87
** Significant at 1%
* Significant at 5%
NS Non-significant

Table 1.11: Analysis of variance (ANOVA) for GCE of mrigal fingerlings fed selenium supplemented purified diets.

The average highest GCE values of 0.281 and 2.68 for mrigal fingerlings were observed at 0.32 and 0.16 mg Se/kg diet respectively. Statistically these GCE values were also found significant at 1% levels. Significant GCE's for these dietary Se levels is due to positive and gradual weight increments in fingerlings.

The food conversion ratio of the fingerlings fed Se supplemented diet have been presented in (table 1.12. It is concluded from the values that FCR is inversely related to the GCE, i.e. wherein fingerlings exhibited highest GCE, lower FCR was recorded. For test of significant FCR values were processed for analysis of variance (ANOVA, Table 1.13).

S.No.	Selenium (mg Se/kg diet)	Fortnightly food conversion ratio FCR in each fortnight			Average FCR (g) for 45 days
		0.15	15-30	31-45	
1.	0.00 Control	4.81	3.65	5.52	4.66
2.	0.01	3.80	3.52	13.35	6.89
3.	0.02	3.51	3.80	4.93	4.08
4.	0.04	4.31	4.61	4.60	4.55
5.	0.08	5.71	4.81	5.10	5.21
6.	0.16	2.40	3.85	9.33	5.19
7.	0.32	2.53	3.53	6.02	4.03
8.	0.64	4.69	5.00	6.62	5.44

FCR for each fortnight FCR for 45 days
SEm ± 0.243
SEm ± 0.140
CD (5%) 0.69
CD (5%) 0.40
CD (1%) 0.92
CD (1%) 0.53

Table 1.12: Food Conversion ratio (FCR) of fingerlings fed on selenium supplemented purified diets for an experimental period of period of 45 days.

S.No.	Source	df	ss	ms	F
1.	0.00 Control	2	5.3466	2.6733	15.02**
2.	0.01	2	187.9098	93.9545	528.13**
3.	0.02	2	3.3774	1.6887	9.49**
4.	0.04	2	0.1742	0.0871	< 1 NS
5.	0.08	2	1.2662	0.6331	3.56*
6.	0.16	2	80.1578	40.0789	225.29**
7.	0.32	2	19.3802	9.6901	54.47**
8.	0.64	2	6.4454	3.2227	18.12**
9.	between level	7	53.9606	7.7087	43.33**
10.	E (error)	48		0.1779	
	TOTAL	71	366.5585		

CV = 8.44
** Significant at 1%
* Significant at 5%
NS Non-significant

Table 1.13: Analysis of variance (ANOVA) for FCR of mrigal fingerlings fed selenium supplemented purified diets.

The result indicates that values of FCR are statistically significant at 1 per cent levels for the fingerlings fed on Se supplemented purified diets. The significant (1 % level) average lower FCR's of 4.03 and 4.08 for fingerlings at concentration of 0.32 and 0.02 mg Se/kg diets were measured with highest average weight gains of respectively 23 and 17 g for a period of 45 days. On the contrary other dietary Se levels, 0.00 (control), 0.01, 0.16 and 0.64 mg Se/kg diets. FCR's were also significant at 1 per cent levels. Whereas Se concentration of 0.08 mg Se/kg diet was noticed significant at 5 per cent levels for the fingerlings.

Dietary requirement for Se has been evaluated for the fingerlings of cirrhinus mrigala in relation to growth response conservation and efficiency. The mrigal fingerling were observed rapidly grow fed on a level of 0.32 mg Se/kg purified diet. On other hand low dietary levels of Se including 0.32 mg/kg diet no deficiency and toxic symptoms have been observed in mrigal fingerling, as in case of catla fingerlings, Posten et al. (1976) demonstrated the dietary essentially of Se for Atlantic Salmon fry and fingerlings and also suggested that no selenium concentrations causing toxicity for Atlantic Salmon, Hitlton et al. (1980) recommended that dietary Se concentration as low as 0.07 mg/kg dry diet, prevented Se deficiency symptom in rain bow trout fingerlings. The dietary supplemented of Se upto a level of 0.32 mg/kg diet were also found helpful for increasing the growth of Cirrhinus mrigala fingerlings. The present study also suggested than a closed water below 0.32 mg Se/litre, the diets of selenium for better growth and survival of Cirrhinus mrigala fingerlings. The supplementation of Se in diets is also beneficial for improving feed conversion efficiency in the cirrhinus mrigala fingerlings as compare to selenium deficient diets.

Dietary requirement for selenium has been evaluated for the fingerlings of Cirrhinus mrigala in relation to growth response, conversion and efficiency selenium is an essential dietary component like other mineral and trace elements for the fish. The mrigal fingerlings were observed rapidly grow fed on a level of 0.32 mg Se/kg purified diet. On other hand low dietary levels of selenium including 0.32 mg/kg diet no deficiency and toxic symptoms have been observed in mrigal fingerlings, as in case of

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