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Effect of *Allium cepa* (Onion) Powder on the Growth and Survival in *Cirrhinus mrigala* Fingerlings

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ABSTRACT

The experiments were conducted using feed prepared with supplementation of onion powder to know their effect on growth performance and survival rate in Cirrhinus mrigala fingerlings (2.65 ± 0.02g). Fingerlings were stocked at a density of 10 nos./experimental tank. Experimental diets were formulated with 35% protein level. T0 diet was considered as control. Onion were added at the rate of 5g, 10g, 20g and 50g per kg of feed in T1, T2, T3 and T4 respectively. The experimental feed was given at the rate of 10% of body weight of the fish twice daily. After 10 days, feeding was decreased to 4% of body weight. After 60 days, Results showed that mean weight gain (%), SGR, PER and survival were significantly higher in T2. The significantly lowest FCR was recorded in T2 (2.65± 0.03) respectively. The survival rate was higher in T2 (97± 0.70), but it was not significantly different among treatments. The results of the present investigation revealed that the supplementation of onion in the diet of C. mrigala fingerlings significantly affected the mean weight gain (%), SGR, PER and survival rate. However, there was significant difference in the survival rate of C. mrigala fingerling among the treatments.

Keywords: *Onion, Cirrhinus mrigala, Growth performance, Survival, Feed utilization.*

INTRODUCTION

The objective of feed formulation in aquaculture is to supply the nutrient density for optimal animal production. Feed cost and feed efficiency are the prime factors that control the farm economy. The availability of nutrients from feed ingredients is essential in determining the nutritional value of the feed ingredient. Traditionally, the feed have been based on animal protein. However, due to cost and availability considerations, it is necessary that plant protein based feed ingredients should be utilized in the feed. Such an application of plant protein source in feed preparation is reported from many countries. Animal protein source, the fish meal is expensive and scares as compared to plant protein source such as compared to plant protein source (Hassan et al., 2012).

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The shortage of animal protein intake in developing countries can be satisfied with proper development of aquaculture. Fish feed is the most expensive input in aquaculture operations. Most of the high cost of feed arises from extensive reliance on protein sources such as fish meal and shrimp meal. To overcome the high cost input in feed, it would be economical to utilize plant ingredients which will enhance fish production. If plant sources can be used as a supplement to animal protein sources, it will not only reduce the production cost and also increases the growth and production (Kaur & Shah, 2017).

The world trend to improve food security and to use natural products will drive the chemically synthesized antibiotics and growth promoters out of use. The search for alternative, natural solutions has begun in order to substitute their use. In order to replace antibiotics, the attention was focused also on plants known to have benefic effects on human health (aromatic plants, medicinal plants, spices and plants extracts). Although the majority of plants are known for centuries and are used in the traditional medicine, their way of action is not fully understood, the existing data being at most empirical (Gabor et al., 2010).

Many biological activities have been recorded for medicinal plants including growth promotion, appetite stimulation, immune stimulation, antimicrobial, and anti-stress in fish. Easy access and the cheap price for many plants are also encouraging factors for their use in large scale in aquaculture to provide better growth and protection at the same time. They have been used in several forms, either as crude, or extracts or active compounds from the plant. Sometimes, they are used in incorporation with a probiotic or with an animal product (Awad & Awaad, 2017).

Regarding the harmful effect of veterinary drugs used in aquacultureeither on fish or on the environment and human health, medicinal plants came as a promising and substitute method forthe control of fish disease. Actually, medicinal plants are used inaquaculture not only as chemotherapeutics but also as feed additives, as they contain a wide variety of nutrients and chemical compounds. Many biological activities have been recorded for medicinal plants including growth promotion, appetite stimulation, immune stimulation, antimicrobial, and anti-stress in fish. Easy access and the cheap price for many plants are also encouraging factors for their use in large scale in aquaculture to provide better growth and protection at the same time. They have been used in several forms, either as crude, or extracts or active compounds from the plant. Sometimes, they are used in incorporation with a probioticor with an animal product (Awad & Awaad, 2017).

The onion (*Allium cepa*) is a member of the Liliaceae family. It contains small quantities of fat, sugar and vitamins A, C and B complex; it is rich in magnesium, potassium and copper (Gabor et al., 2010). In addition, onion is used as a vegetable, spice and a medicinal plant where it is an antibiotic, antiseptic, anti-infectious, antibacterial and antifungal agent, antioxidant, and/or anticancer effects (Bello et al., 2012b, Bello et al., 2012a, Benkeblia et al., 2004, Jeong et al., 2009, Ramos et al., 2006). Onion (*A. cepa*) has a high content of free and glycosidically bonded quercetin and oxidized quercetin derivatives (Griffiths et al., 2002, Suh et al., 1999). It reduces endogenous lipogenesis and increases catabolism of lipids (Kumari & Augusti, 2007). Onions contain a wide variety of micro constituents such as trace elements, vitamins, flavonoids and sulfur compounds (Breu, 1996), which may have protective effects against cancer. Additionally, a previous study revealed that onion powder was one of the most effective dietary additives tested that improve lysozyme activity of the Olive flounder (*Paralichthy solivaceus*) juvenile (Cho et al., 2012).

With this background information, this study was carried out to systematically evaluate the effects of *A. cepa* (onion) powder on growth and survival of mrigal (*Cirrhinus mrigala*) fingerlings.

MATERIALS AND METHODS

Fish and management

The experiment was conducted at the Wet Laboratory of Department of Aquaculture, College of Fisheries Science, JAU, Veraval, over a period of 60 days. Fingerlings of *Cirrhinus mrigala* were collected from Government Fish Hatchery, Ukai, Gujarat and transported in polythene bags by road to Veraval. The fish were brought to Aquaculture Wet Laboratory of College of Fisheries Science, JAU, Veraval, and were allowed to remain in the plastic tank (500 L) with continuous aeration and feeding for 10 days. Fingerlings with a total weight of 2.64 ± 0.02g to 2.72 ± 0.05g were selected for the experiment. The experiment was conducted in rectangular plastic aquarium tanks of 40 litres capacity with the size of 2x1x1 feet. Aquarium tanks were filled with fresh water up to 30 litres.

The experimental set-up consisted of 20 plastic tanks. In this, 20 plastic tanks were set-up for *Tulsi* powder. The tanks were washed with potassium permanganate solution (4 ppm) thoroughly and cleaned with fresh water. Two hundred (200) fishes were distributed in five distinct experimental groups under each experiment. Each plastic tank containing 30 L chlorine free water was stocked with 10 fishes. Water used for the entire experiment was sourced from bore-well (ground water source). Aeration was provided through the aerators. The aeration pipe in each tank was provided with an air stone and a plastic regulator to control the air pressure uniformly in the entire tank.

Treatment details of Experiment

Table 1: Experiment: *Allium cepa* (Onion) Powder					
Treatment Groups	**T0**	**T1**	**T2**	**T3**	**T4**
	Gram of herbal powder per kg feed				
	0	**05**	**10**	**20**	**50**

Collection of plant materials

Onion powder was brought from local market.

Composition of experimental diets (%)

Table 2: Composition of diets

Ingredients (%)	**Treatments**				
	T0	**T1**	**T2**	**T3**	**T4**
Fish Meal	58	58	58	58	58
Wheat Bran	10	10	10	10	10
Wheat flour	23	22.5	22	21	18
Binder	2	2	2	2	2
Sun Flower Oil	3	3	3	3	3
Fish Oil	3	3	3	3	3
Vitamin & mineral	1	1	1	1	1
Onion	0	0.5	1	2	5
Total	100	100	100	100	100

Preparation of experimental diets

The experimental diet was formulated with 35% protein level using locally available ingredients. The onion powder was added to other ingredients separately and diets were blended for 40 min to make a paste of each diet. For each treatment, there were four replications. The required quantities of ingredients were collected and weighed accurately as per feed formula as shown in Table 2. The ingredients were mixed well with the required quantity of water in an enamel tray to prepare dough. The prepared dough was thermally processed at 121^{o}C and 15 lbs pressure for 10-15 minutes and then cooled at room temperature. After cooling of dough, the vitamin-mineral mixture, sunflower oil, fish oil and feed supplements (onion) were added as per the treatment details (Table 2) and mixed well. The feed mixture was then pelletized in the form of pellets using hand pelletizer. The size of the pellets was approximately 1-2 mm. The pellets were spread on a plastic sheet, exposed to sunlight for 2-3 hours every day for 2 days and dried till the moisture content was reduced to less than 10%. The pelleted feed was then packed in marked plastic jars.

Table 3: Proximate composition of experimental diets containing onion powder

Sr. No.	Composition	Treatments				
		T0	T1	T2	T3	T4
1	Protein	35.79	34.96	35.09	35.54	34.76
2	Fat	15.36	15.17	15.73	15.81	15.26
3	Moisture	5.90	4.86	5.45	5.91	5.20
4	Ash	21.36	21.45	21.82	22.31	22.19

Analysis of Physio-Chemical Water Parameters

Water quality parameter such as temperature, pH, dissolved oxygen and total hardness were measured on weekly basis throughout the experimental period. The temperature of each tank was measured by using of the mercury thermometer and pH was measured by pH meter, respectively. Dissolved oxygen and total hardness were measured using wrinkler's method and EDTA method respectively.

Statistical Analysis

One-way Analysis of Variance (ANOVA) was applied to test the significance of the treatments at 5% error level. The data analysis was undertaken at Department of Agricultural Statistics, Junagadh Agricultural University, Junagadh.

RESULT

The Effect of Onion (*A. cepa*) Incorporated Diet on Growth of *C. mrigala* Fingerlings

Mean weight gain (%)

The mean weight was calculated for each tank at each fortnight interval. The initial mean weight recorded were 2.47± 0.11g, 2.4± 0.03g, 2.30± 0.02g, 2.30± 0.02g and 2.31± 0.05g in treatment T0, T1, T2, T3 and T4 respectively. At the end of experiment the final mean weight recorded were 5.19±0.02g, 5.31±0.07g, 5.50±0.06g, 5.30±0.02g and 5.31±0.03g in treatment T0, T1, T2, T3 and T4 respectively. The highest final mean weight (g) was observed in T3 and lowest in T0 treatment. Mean weight of *C. mrigala* fingerlings at each fortnight interval for 60 days of culture period is presented in Table 4.

Table 4: Mean weight (g) of *C. mrigala* fed with onion supplemented diets during experimental period (n=1 fish, Mean± SE)

Treatments	Days				
	0	15	30	45	60
T0	2.47 ± 0.11	3.36 ± 0.01	3.85 ± 0.01	4.36 ± 0.05	5.19 ± 0.02
T1	2.4 ± 0.03	3.35 ± 0.03	3.90 ± 0.02	4.43 ± 0.10	5.31 ± 0.07
T2	2.30 ± 0.02	3.22 ± 0.04	4.08 ± 0.05	4.51 ± 0.08	5.50 ± 0.06
T3	2.30 ± 0.02	2.98 ± 0.04	3.72 ± 0.12	4.39 ± 0.06	5.30 ± 0.02
T4	2.31 ± 0.05	3.22 ± 0.03	3.64 ± 0.07	4.30 ± 0.07	5.31 ± 0.03

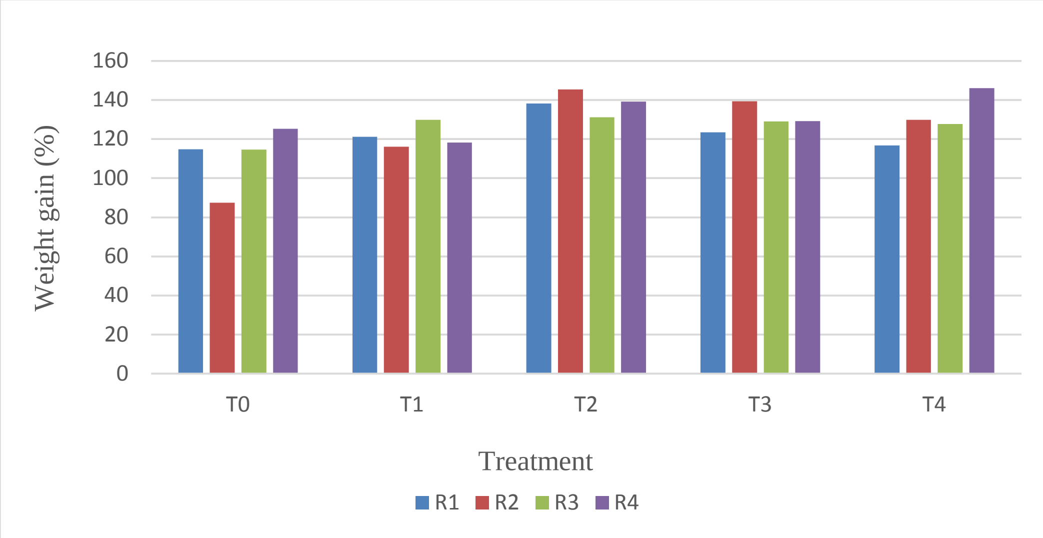

Fig. 1: Mean weight gain (%) of *C. mrigala* fed with onion supplemented diets at the end of experimental period

Specific growth rate (%)

The specific growth rate (SGR) of *C. mrigala* fingerlings in different treatments is given in Table 5. At the end of the experiment, specific growth rate recorded were 4.520±0.15, 4.849±0.10, 5.324±0.10, 4.999±0.06 and 5.012±0.13 in treatment T0, T1, T2, T3 and T4 respectively. The maximum specific growth rate was observed in T2 and minimum in T0. The statistical analysis revealed the significant difference in specific growth rate among the treatment (P<0.05, Table 5, Fig. 2). Treatment T2 showed significantly higher SGR compared to other treatments.

Table 5: Specific growth rate (%) of *C. mrigala* fed with onion supplemented diets at the end of experimental period (Mean ± SE)

Days	Treatments				
	T0	T1	T2	T3	T4
60	$4.52^{a}\pm 0.15$	$4.84^{ab}\pm 0.10$	$5.32^{c}\pm 0.10$	$4.99^{bc}\pm 0.06$	$5.01^{bc}\pm 0.13$

Mean values with different superscripts in the same row are significantly different (P<0.05)

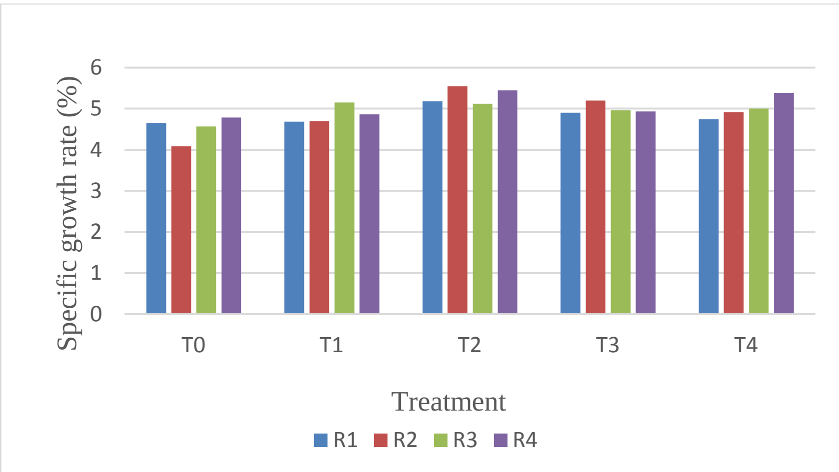

Fig. 2: Specific growth rate (%) of *C. mrigala* fed with onion supplemented diets at the end of experimental period

Feed conversion ratio (FCR)

The feed conversion ratio (FCR) of *C. mrigala* fingerlings in different treatments is given in Table 6. At the end of the experiment, feed conversion ratio recorded were 3.122±0.12, 2.909±0.05, 2.65±0.03, 2.68±0.04 and 2.69±0.08 in treatment T0, T1, T2, T3 and T4 respectively. The lowest feed conversion ratio was observed in T2 and highest in T0. The statistical analysis revealed that there was significant difference in feed conversion ratio of fishes fed with different feeds (P<0.05, Table 6, Fig 3).

Table 6: Feed conversion ratio (FCR) of *C. mrigala* fed with onion supplemented diets at the end of experimental period (Mean ± SE)

Days	Treatments				
	T0	**T1**	**T2**	**T3**	**T4**
60	3.12^{c}± 0.12	2.90^{bc}± 0.05	2.65^{a}± 0.03	2.68^{ab}± 0.04	2.69^{ab}± 0.08

Mean values with different superscripts in the same row are significantly different (P<0.05)

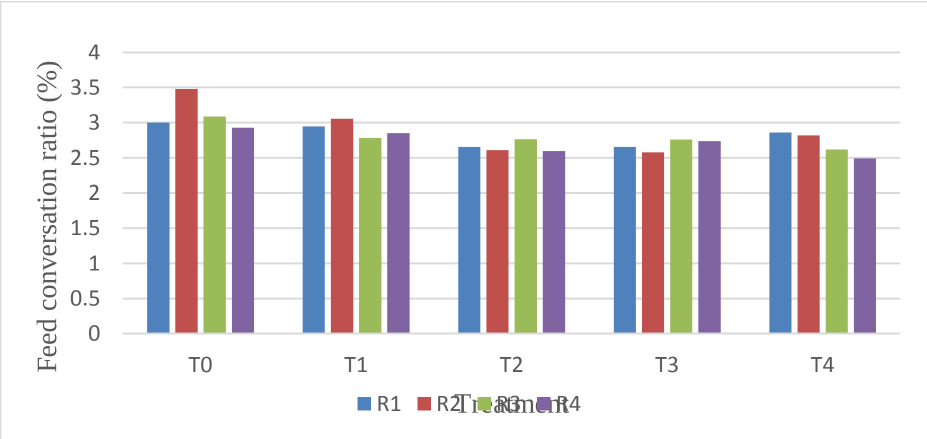

Fig. 3: Feed conversion ratio (FCR) of *C. mrigala* fed with onion supplemented diets at the end of experimental period

Protein efficiency ratio (PER)

The result on protein efficiency ratio of *C. mrigala* fingerlings under different experiments are given in Table 7. At the end of the experiment, protein efficiency ratio recorded were 0.898±0.03, 0.964±0.03, 1.05±0.01, 1.06±0.01 and 1.09±0.03 in treatment T0, T1, T2, T3 and T4 respectively. The highest protein efficiency ratio was observed in T4 and lowest in T0. The statistical analysis revealed that there was significant difference in protein efficiency ratio of fishes fed with different feeds (P<0.05, Table 7, Fig 4).

Table 7: Protein efficiency ratio (PER) of *C. mrigala* fed with onion supplemented diets at the end of experimental period (Mean ± SE)

Days	Treatments				
	T0	**T1**	**T2**	**T3**	**T4**
60	0.898^{a}± 0.03	0.964^{a}± 0.03	1.058^{b}±0.01	1.068^{b}±0.01	1.092^{b}±0.03

Mean values with different superscripts in the same row are significantly different (P<0.05)

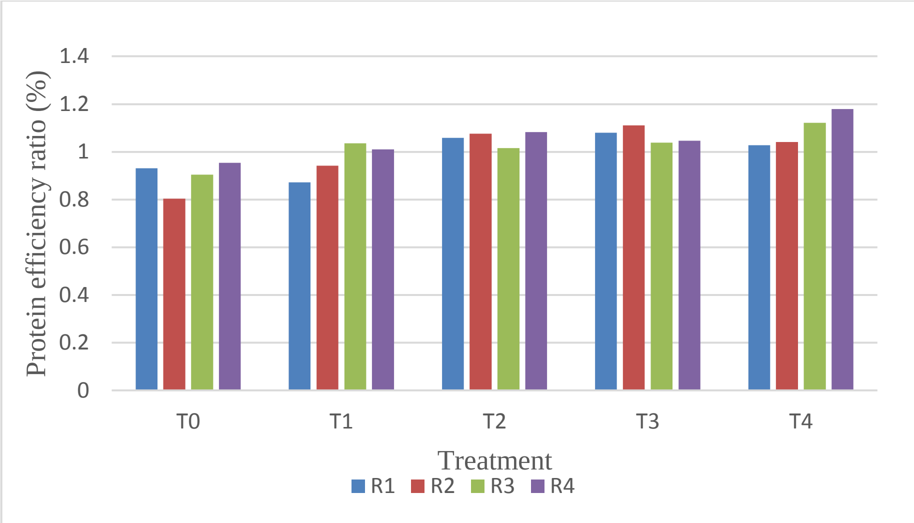

Fig. 4: Protein efficiency ratio (PER) of *C. mrigala* fed with onion supplemented diets at the end of experimental period

Effect of *A. cepa* incorporated diets on survival of *C. mrigala* fingerlings

Survival (%) of *C. mrigala* fingerlings in the various treatments at the end of experiment is detailed in Table 8. The highest survival was observed in the T2. However, there was found significant difference among the treatments (P>0.05, Table 4.11). Survival as observed in respective treatments is shown in Fig. 5.

Table 8: Mean survival (%) of *C. mrigala* fed with onion supplemented diets at the end of experimental period (Mean ± SE)

Days	Treatments				
	T0	**T1**	**T2**	**T3**	**T4**
60	91.25[a]± 0.47	93.75[b]±0.47	97[c]± 0.70	95.25[bc]±0.62	95.5[bc]± 0.64

Mean values with different superscripts in the same row are significantly different (P>0.05)

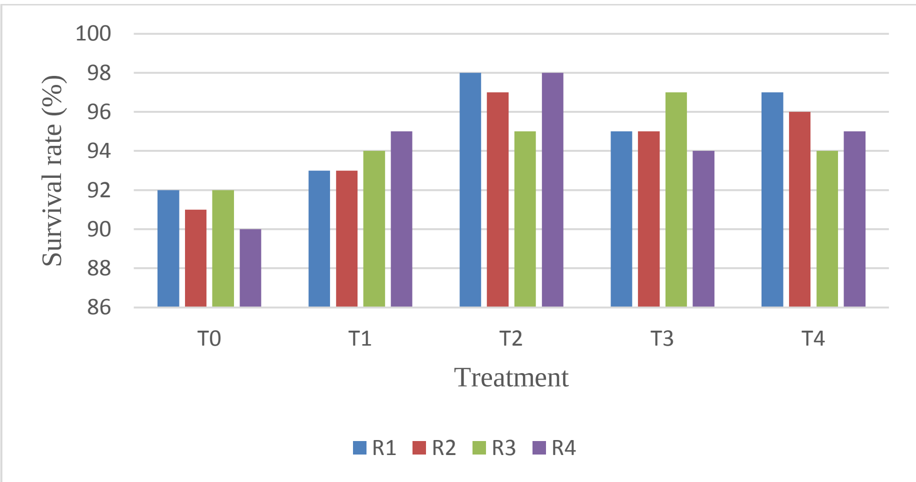

Fig. 5: Survival (%) of *C. mrigala* fed with onion supplemented diets at the end of experimental period

Physico-chemical water parameters

The water quality parameter such as temperature, pH, dissolved oxygen (DO) and total hardness were analyzed during this experiment on weekly basis.

Temperature

Water temperature in different experimental tanks was recorded weekly. The mean data of temperature (^{O}C) during study period are shown in Table 9. During the whole experimental period, water temperature ranged from 22±0.40 to 26.75±0.25^{O}C. The temperature was found within the optimum range throughout the experimental period.

Table 9: Mean water temperature (^{O}C) during the experimental period

Weeks	Treatments (Mean ± SE)				
	T0	T1	T2	T3	T4
1st	26.25± 0.47	26.25± 0.25	25.75± 0.25	26.5± 0.28	26.25± 0.47
2nd	26.5± 0.28	26.25± 0.47	26.75± 0.25	26.5± 0.64	26.5± 0.28
3rd	25.75± 0.25	26.25± 0.47	26.25± 0.47	25.5± 0.28	25.25± 0.25
4th	24.75± 0.47	24.75± 0.47	25 ± 0.40	25± 0.40	24.25± 0.25
5th	24.75± 0.47	24.5± 0.28	24.75± 0.47	24.5± 0.5	24.75± 0.47
6th	25.25± 0.47	24.5± 0.5	25± 0.40	25.5± 0.28	25.25± 0.25
7th	22.5± 0.28	22.5± 0.28	22.25± 0.25	22.25± 0.25	22± 0.40
8th	22.5± 0.5	22± 0.40	22.5± 0.28	22.25± 0.47	22.5± 0.28

pH

The water pH in all experimental tanks was analyzed weekly. The mean values pH during the experimental period is shown in Table 10. During the whole experimental period, water pH ranged from 7.22±0.00 to 7.72±0.05. The pH was within the optimum range throughout the experiment period.

Table 10: Mean water pH during the experimental period

Weeks	Treatments (Mean ± SE)				
	T0	T1	T2	T3	T4
1st	7.70±0.00	7.73±0.06	7.66±0.01	7.74±0.06	7.68±0.05
2nd	7.68±0.00	7.93±0.02	7.68±0.00	7.68±0.00	7.85±0.03
3rd	7.76±0.00	7.66±0.00	7.66±0.01	7.66±0.01	7.87±0.00
4th	7.90±0.09	7.92±0.04	7.95±0.02	7.85±0.06	7.80±0.07
5th	8.00±0.04	8.00±0.04	8.05±0.02	8.02±0.04	8.07±0.06
6th	7.92±0.02	8.00±0.07	7.97±0.04	7.97±0.04	8.10±0.04
7th	8.04±0.03	8.12±0.02	7.93±0.03	7.94±0.02	8.12±0.05
8th	7.97±0.01	8.00±0.03	7.92±0.02	7.96±0.02	8.01±0.01

Dissolved Oxygen (DO)

The dissolved oxygen (DO) in all experimental tanks was analyzed weekly. The mean data of dissolve oxygen during experimental period are shown in Table 11. During the experimental period, dissolved oxygen ranged from 4.95±0.11 to 7.00±0.12 ppm. The dissolved oxygen was found within the ideal range throughout the experimental period.

Table 11: Mean dissolved oxygen (ppm) during the experimental period

Weeks	Treatments (Mean ± SE)				
	T0	T1	T2	T3	T4
1st	5.32±0.09	5.02±0.17	5.09±0.04	5.00±0.11	5.20±0.16
2nd	5.90±0.12	5.42±0.10	6.60±0.34	5.10±0.19	6.20±0.25
3rd	5.40±0.25	5.70±0.10	6.20±0.11	5.40±0.11	5.70±0.19
4th	5.60±0.16	5.80±0.25	5.80±0.11	5.90±0.19	5.60±0.16
5th	6.10±0.19	5.90±0.19	5.90±0.10	6.00±0.16	6.70±0.16
6th	6.37±0.11	6.17±0.10	6.07±0.16	5.90±0.11	6.20±0.12
7th	6.22±0.10	6.05±0.26	7.20±0.18	6.30±0.30	7.10±0.19
8th	6.02±0.26	6.22±0.10	7.20±0.13	6.00±0.14	6.40±0.21

Total Hardness

The total hardness was analyzed weekly. The mean data of total hardness (ppm) during experimental period are shown in Table 12. During the whole experimental period, water total hardness ranged from 231.5±1.89 to 315.0±2.49 ppm. It was found within the optimum range throughout the experimental period.

Table 12: Mean total hardness (ppm) during the experimental period

Weeks	Treatments (Mean ± SE)				
	T0	T1	T2	T3	T4
1st	276.0±4.71	289.0±0.00	278.0±5.47	271.5±5.67	271.0±3.00
2nd	238.5±2.06	243.0±4.50	227.5±1.50	237.0±1.73	231.5±1.89
3rd	233.0±1.29	240.0±3.40	227.0±1.73	233.0±1.00	228.5±1.50
4th	265.5±1.70	265.0±0.95	264.0±2.16	266.5±1.50	263.5±1.25
5th	272.5±2.62	263.0±1.25	276.0±2.94	267.0±1.29	265.0±0.57
6th	277.0±3.00	271.0±3.31	277.0±1.73	278.2±1.75	274.0±3.09
7th	289.0±4.42	287.5±2.50	295.0±6.45	292.5±5.18	289.0±4.20
8th	315.0±2.49	302.0±4.78	310.2±4.09	313.5±3.52	315.0±2.52

DISCUSSION

In the present study, highest SGR was observed in treatment T2 showed maximum SGR (5.324±0.10) compared to control diet (4.520±0.15). Gradual improvement in growth performance indices was recorded by Norhan *et al.*[15] coinciding with increasing onion powder inclusion level in sea bass diets. The values of weight gain (%) and SGR in fish fed 5-10g/kg diets were relatively similar and in significantly different comparing with each other but significantly different. According to Akrami et al. (2015) the specific growth rate of the *Huso huso* increased when the concentration of onion powder was increased in the experiment diet. The significantly highest SGR was obtained in fishes fed with 1.0g/kg onion powder incorporated diet. In the present experiment, similar trend was observed when fish fed with more concentration of onion in diet. Mahmoud et al. (2017) reported the maximum SGR at 50mg/kg diet compared to control diet in *O. niloticus* fishes. They found maximum SGR in minimum amount of curcumin incorporated diet compared to other treatment.

Akrami et al. (2015) reported that the onion powder fed fishes showed FCR value compared to control diet. Norhan et al. (2015) studied effect of onion on sea bass. They observed the minimum FCR value compared to control diet. Similarly, in the present study the onion incorporated diet showed lower FCR than control one. Mahmouda et al. (2017) studied the influence dietary curcumin supplement on *O. niloticus* and reported that improved FCR value at the end of experiment. Akrami et al. (2015) reported that the onion powder fed fishes showed PER value compared to control diet in *Huso huso* and found that the PER value increased with the increase of concentration of onion powder in the diet. In the present study also, the PER value was found to be maximum when the onion concentration increased in the experimental diet.

Norhan et al. (2015) reported that the survival of the fishes increased with increase in the concentration of onion level in diet of sea bass compared to control diet. Mahmouda et al. (2017) reported the highest survival rate at lower concentration of dietary curcumin supplementation in the diet of *O. niloticus*. This was contrary to the result obtained in the present study.

CONCLUSIONS

The results obtained under the present study revealed that mean weight gain (%), SGR, PER and survival rate were significantly higher in T2. The significantly lowest FCR was also recorded in T2. The survival rate was found to be higher in T2.

Based on these results it can be concluded that the addition of 10.00g onion powder/ kg diet of *C. mrigala* fingerling is better for the higher mean weight gain (%), SGR, PER, lower FCR and better survival rate of *C. mrigala* fingerlings.

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