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Shivanshu Nigam
 Department of Aquaculture,
 College of Fisheries, Maharana
 Pratap University of Agriculture
 and Technology, Udaipur,
 Rajasthan, India

SK Sharma
 Dean, Department of
 Aquaculture, College of
 Fisheries, Maharana Pratap
 University of Agriculture and
 Technology, Udaipur,
 Rajasthan, India

BK Sharma
 Dean, Department of
 Aquaculture, College of
 Fisheries, Maharana Pratap
 University of Agriculture and
 Technology, Udaipur,
 Rajasthan, India

ML Ojha
 Dean, Department of
 Aquaculture, College of
 Fisheries, Maharana Pratap
 University of Agriculture and
 Technology, Udaipur,
 Rajasthan, India

SS Sharma
 Dean, Rajasthan College of
 Agriculture, Maharana Pratap
 University of Agriculture and
 Technology, Udaipur,
 Rajasthan, India

B Upadhyay
 Department of Statistics,
 Rajasthan College of Agriculture,
 Maharana Pratap University of
 Agriculture and Technology,
 Udaipur, Rajasthan, India

Corresponding Author:
Shivanshu Nigam
 Department of Aquaculture,
 College of Fisheries, Maharana
 Pratap University of Agriculture
 and Technology, Udaipur,
 Rajasthan, India

Effect of pearl millet (*Pennisetum glaucum*) mixed feed on water quality and growth performance of *Cyprinus carpio* var. *communis* (Linnaeus, 1758) fingerlings

Shivanshu Nigam, SK Sharma, BK Sharma, ML Ojha, SS Sharma and B Upadhyay

Abstract

The impact of pearl millet (*Pennisetum glaucum*) mixed feed on the growth performance of fingerlings of *Cyprinus carpio* var. *communis* (Linnaeus, 1758) was evaluated. The experiment was carried out for 60 days. Experimental diets were formulated by adding pearl millet flour substituting an equivalent proportion of rice bran in control diet at five different levels i.e., T₁ (06%), T₂ (12%), T₃ (18%), T₄ (24%), and T₅ (30%). T₀ (control) i.e., without adding pearl millet. The fish were fed at a rate of 3% of their body weight once in a day. The pearl millet mixed feed has not shown any detrimental effects on the fish survival, growth and water quality parameters. The range of water quality parameters, were: air temperature between 27.2 and 29.2 °C, water temperature between 27.0 and 28.4 °C, Electrical conductivity between 160 and 192 µS/cm-1, pH between 6.7 and 7.60, dissolved oxygen between 6.1 and 8.0 mg/l, total alkalinity between 104 and 151 mg/l, and total hardness between 420 and 664 mg/l, nitrate between 0.021 and 0.089 mg/l and orthophosphate 0.041 and 0.88 mg/l. The experimental fish *Cyprinus carpio* var. *communis* shows increased growth performance by the administration of pearl millet in mixed diet. The highest weight gain was 23.600±0.155 g noticed in T₄ at 24% inclusion of pearl millet, and the lowest was 21.428±0.029 g in T₀ (control). Without pearl millet the highest percent weight gain was noticed in T₄ (54.895±0.341%), and the lowest was 51.388±0.234% in T₀ (control). The lowest FCR was 2.697±0.014 in T₄, and the highest was 2.863±0.008 in T₀ (control). The highest SGR was found to be 0.985±0.003% in T₄, and the lowest was 0.917±0.002% in T₀ (control). The highest GCE was observed at (0.362±0.003) in T₂ and the lowest (0.349±0.001) in T₀ (control).

Keywords: *Cyprinus carpio* var. *communis*, water qualities, *Pennisetum glaucum*

1. Introduction

The fishing sector in India contributes significantly to the country's economy. It provides major foreign exchange and jobs for millions of people. India is the second-largest fish producer in the world, accounting for 6.56% of global fish production. About 1.1% contribution is a Fisheries sector in Indian economy. More than 41.27 lakh tonnes of fish are produced by the maritime industry, and 121.21 lakh tonnes are produced by inland fisheries. India produced 162.48 lakh tonnes of fish in total in 2021-22. Additionally, the fisheries sector's export revenues, which totaled Rs 56,562.85 crore in 2021-22, grew at an excellent average growth rate of around 0.16%. Andhra Pradesh, West Bengal, Karnataka, Odisha, and Gujrat major evolve to be leading fish-producer states in India during 2021-22. (SOFIA, 2022) [12].

Rajasthan is the biggest state in India. This state is recognised as having abundant water resources because it has four river basins: The Chambal River basin, the Mahi River basin, the Luni River basin, and the Ghaggar River basin. Approximately 70 rivers connect these significant river systems with numerous tanks, ponds, and reservoirs throughout the monsoon season, controlling fish reproduction and other aquatic life organically throughout the state. There are resources for freshwater and saltwater. In the state, there are a total of 15,828 water bodies that cover 4.23 lakh hectares, excluding 30,000 ha area covered by rivers and canals, the 80,000-ha covered by waterlogged area. there is also 1.80 lakh-ha. salt-affected area available for aquaculture and other. On an average, the state produces 200 kg of fish per hectare. (Anonymous, 2023a) [3].

Rajasthan is the largest producer of millet in India. In India, millet comes in various forms, such as buckwheat, canary seeds, finger millet, jowar (sorghum) and bajra (pearl millets). The majority of India's millet production is made up of sorghum (Jowar) and pearl millet (Bajra).

It has been grown throughout Africa and the Indian subcontinent from the ancient history. (Anonymous, 2022)^[2]. In various pearl millet genotypes, the grain's starch content ranged from 62.8 to 70.5%, coupled with soluble sugars of 1.2 to 2.6% and 21.9 to 28.8% (Chavan, 1988)^[7]. Starch (56.3 to 63.7%) and amylose (18 to 24.6%) levels are lower in several high-yielding Indian pearl millet types (Singh, 2015)^[11]. In Rajasthan, an area of 43,483,396 hectare is cultivated under pearl millet. In Rajasthan, 58,19,743 million tonnes of pearl millet were produced in 2022. Where a yield of 1336 kg/ha and a 79% output share were recorded. Pearl millet has high dietary nutritional value (Rajasthan Agriculture Statistics, 2019) and greater energy content than sorghum and is equivalent to brown rice due to its high quantity of unsaturated fatty acids (75%) and linoleic acid (46.3%) (Jaybhaye *et al.* 2014)^[9].

The objectives of the aquaculture as a developing sector are to achieve maximum growth and produce fish of the highest grade with reduced production cost and cheaper feed nutrients. The present study was conducted to know the "Effect of Pearl millet (*Pennisetum glaucum*) mixed feed on growth performance and digestibility of *Cyprinus carpio* var. *communis* (Linnaeus, 1758) fingerlings".

2. Material and Methods

2.1 Site of experiment

This study was conducted at the aquaculture laboratory of the Department of for a period of 60 days in 18 plastic tanks with 225 litres of water holding capacity. Experimental fish *Cyprinus carpio* var. *communis* fingerlings were obtained from the Aquaculture Research and Seed Production Unit, Directorate of Research (MPUAT), Udaipur. Apparently healthy fish fingerlings placed in circular FRP tanks of 500-liter capacity to acclimatise for a week. Proper aeration and a basal diet were provided during the acclimatisation phase.

2.2 Water quality parameters

Water quality parameters *viz.* air and water temperature, dissolved oxygen, pH, total alkalinity, total hardness, nitrate nitrogen and orthophosphate were analysed at an interval of 15 days by following standard method of APHA (2017)^[4].

3. Preparation of control diet and experimental diet

The control diet was prepared by mixing groundnut oilcake (GNOC), rice bran (RB), wheat flour (WF), fish meal (FM), vegetable oil (F) and vitamin mineral mixture in a ratio of 40:30:14:10:3:2, respectively. The experimental diet was prepared analysis of growth parameters. The experimental diets were formulated by adding pearl millet flour substituting an equivalent proportion of rice bran in control diet at five different levels *i.e.*, T₁ (06%), T₂ (12%), T₃ (18%), T₄ (24%), and T₅ (30%). T₀ (control) *i.e.*, without adding pearl millet. The fish were fed at a rate of 3% of their body weight once in a day.

3.1 Analysis of growth parameters

3.1.1 Results and Discussion

The air and water quality is essential for profitable fish rearing. For the present study ground water was used. Different chemical water quality parameter *viz.* air and water (°C), EC ($\mu\text{S}/\text{cm}^{-1}$), pH, dissolved oxygen (mg/l), total alkalinity (mg/l), total hardness (mg/l), orthophosphate (mg/l) and nitrate nitrogen (mg/l) were noted and range of minimum-

maximum and average value are described in Table 1.

3.1.2 Water-quality parameter

The average air and water air temperature were comparatively low in the beginning of experiment but after progressive increase in duration of experiment an increasing trend was seen according to the change in weather from 29 March to 28 May 2023 The air temperature was found minimum and maximum 27.2 °C and 29.2 °C respectively. The Suitable temperature range responsible good for fish culture was ascertained 17.7 – 28.6 °C.

The electrical conductivity found in this investigation was minimum 160 $\mu\text{S}/\text{cm}^{-1}$ in T₂. While the maximum value of EC was observed 192 $\mu\text{S}/\text{cm}^{-1}$ in T₁ and T₂. However, Stone and Thomforde, (2004)^[13] was found that fish-suitable water has an electrical conductivity range of 100 - 2,000 m S/cm-1.

The pH of the water used in this experiment varied from 7.1 to 8.30. The minimum pH of water was recorded 7.1 in T₁ and T₄. The maximum pH of water was 8.30 in T₄. According to Zou *et al.* (2016)^[14], the largest fish biomass was produced when the pH ranged from 7.5 to 9.0, showing that a neutral or slightly alkaline environment was better for the development of *Cyprinus carpio*.

The range of dissolved oxygen fluctuate was between 6.1 and 8.0 mg/l. The minimum average value of dissolved oxygen was 6.79 mg/l in T₀, and the maximum average value was 6.91 mg/l in T₅. According to Bhatnagar, and Devi, (2013)^[5], the best suitable range of dissolved oxygen is between 5-10 mg/l for fish growth and health.

The average total alkalinity was noticed 126.4 mg/l in T₁ and maximum 127.4 mg/l in T₄. the lowest total alkalinity, which was 106 mg/l, T₀ and T₄, T₅ had the highest total alkalinity, which was 151 mg/l in T₃. According to Stone and Thomforde (2004)^[13], the optimal alkalinity range for CaCO₃ digestion and development is between 50 and 150 mg/l.

The total hardness of experimented water was measured in the present research period between 420 and 496 mg/l. The lowest average value of total hardness, 453.2 mg/l, was found in T₀, while the highest average value, 455.0 mg/l, was found in T₂. According to Choudhary and Sharma (2018)^[8] the water hardness 488.56 to 530.00 mg/l is found best for growth of fish.

The nitrate- nitrogen of experimental water was measured in the present research period between 0.021 to 0.089 mg/l. The lowest average value of nitrate- nitrogen, 0.045 mg/l was found in T₂. While the highest average value, 0.071 mg/l was found in T₄. Santhosh and Singh. (2007)^[11] while laying guidelines for water quality management in fish culture, found that Nitrate was determined to be good if ranges between 0.1 to 4.0 mg/l.

The orthophosphate of experimental water was measured in the present research period between 0.410 to 0.880 mg/l. The lowest average value of orthophosphate, was 0.602mg/l found in T₀. In contrast, the highest average value, 0.617 mg/l was found in T₅. The lowest nitrate-nitrogen was 0.41 mg/l in T₅, and the highest total nitrate- nitrogen was 0.88 in T₃. (Table 1 and Figure 1). One of the essential nutrients that is used by both plants and fish is phosphate. Along with calcium it is very important for growth and bone formation. In fish dietary intake is the only way to get this mineral (Bussel *et al.*, 2013)^[6].

3.1.3 Growth parameter

The experimental fish *Cyprinus carpio* var. *communis* shows increased growth performance by the administration of pearl millet in mixed diet. According to Allameh *et al.* (2000)^[1] the impact of a few carbohydrate sources (corn, barley, and millet) and the substitution of corn with varying amounts of barley and millet (0, 25, 50, 75, and 100%) was significant on the growth of common carp (*Cyprinus carpio* L.). The highest weight gain was 23.600±0.155 g noticed in T₄ at 24% inclusion of pearl millet, and the lowest was 21.428±0.029 g

in T₀ (control). Without pearl millet the highest percent weight gain was noticed in T₄ (54.895±0.341%), and the lowest was 51.388±0.234% in T₀ (control). The lowest FCR was 2.697±0.014 in T₄, and the highest was 2.863±0.008 in T₀ (control). The highest SGR was found to be 0.985±0.003% in T₄, and the lowest was 0.917±0.002% in T₀ (control). The highest GCE was observed at (0.362±0.003) in T₂ and the lowest (0.349±0.001) in T₀ (control). The statistical analysis of growth parameter indicates significant difference (P < 0.05). (Fig 2)

Table 1: Range of water quality parameters during experimental period in different treatment

Parameters	T ₀	T ₁	T ₂	T ₃	T ₄	T ₅
Air Temperature	27.2-29.2					
(°C)	(28.3)					
Water Temperature	27.0-28.4	27.0-28.2	26.3-28.4	26.1-28.3	27.0-28.3	27.0-28.2
(°C)	(27.6)	(27.6)	(27.6)	(27.7)	(27.6)	(27.4)
Electric	162-189	161-192	160-1.92	161-189	161-189	162-189
Conductivity	(174.6)	(173.8)	(175.0)	(175.4)	(174.2)	(175.0)
(µS/cm-1)						
pH	7.1-8.2	7.2-8.22	7.2-8.23	7.3-8.26	7.1-8.30	7.3-8.28
	(7.63)	(7.66)	(7.67)	(7.67)	(7.68)	(7.68)
Dissolved oxygen	6.1-7.6	6.3-7.6	6.2-7.8	6.1-7.7	6.2-8	6.2-8
(mg/l)	(6.79)	(6.86)	(6.89)	(6.82)	(6.90)	(6.91)
Total Alkalinity	106-148	108-146	108-146	106-151	106-148	108-146
(mg/l)	(127.68)	(126.4)	(127.0)	(127.2)	(127.4)	(126.8)
Total Hardness	420-490	422-494	422-496	430-490	420-492	420-492
(mg/l)	(453.2)	(453.4)	(455.0)	(455.2)	(460.36)	(460.36)
Nitrate (mg/l)	0.021-0.080	0.023-0.064	0.027-0.089	0.024-0.083	0.26-0.087	0.024-0.082
	(0.048)	(0.045)	(0.051)	(0.048)	(0.052)	(0.050)
Orthophosphate (mg/l)	0.43-0.82	0.44-0.81	0.45-0.86	0.45-0.88	0.46-0.84	0.041-0.808
	(0.602)	(0.604)	(0.614)	(0.616)	(0.612)	(0.617)

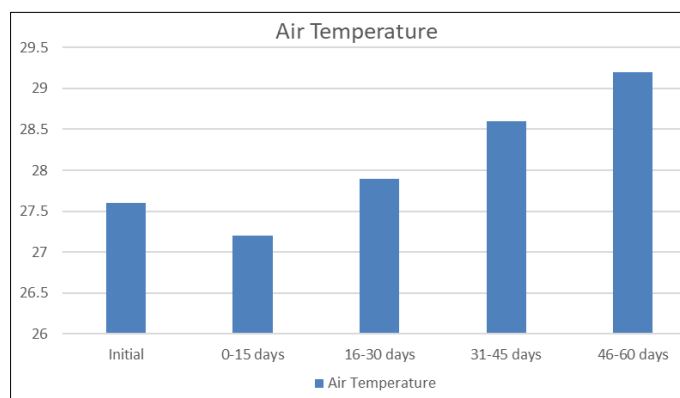


Fig 1: Air temperature during the experimental period

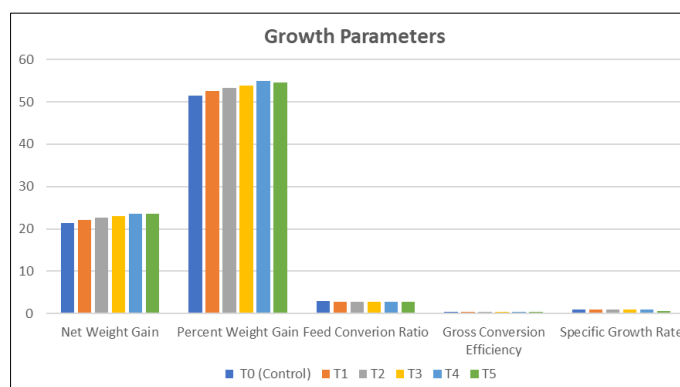


Fig 2: Summary of growth parameters of *Cyprinus carpio* fingerlings

4. Conclusion

Through water quality factors are crucial for improving freshwater aquaculture productivity. It can be concluded from the present study air and water temperature, EC, pH, DO, Total alkalinity, Total hardness, Nitrate and Orthophosphat was found in optimum range and does not show any adverse effect among all treatment on the fish growth. it can be inferred that including pearl millet in fish diets at a level of 24% replacing equal amount of rice bran can enhance fish growth and the aquaculture output with better cost effectiveness.

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