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

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### Abstract

A 60 days feeding trial was carried out to find out the impact of pearl millet (*Pennisetum glaucum*) mixed feed on the growth performance of fingerlings of *Cyprinus carpio* var. *communis* (Linnaeus, 1758). Experimental diets were formulated by adding pearl millet flour substituting an equivalent proportion of rice bran in the control diet at five different levels i.e., T<sub>1</sub> (06%), T<sub>2</sub> (12%), T<sub>3</sub> (18%), T<sub>4</sub> (24%), T<sub>5</sub> (30%), and T<sub>0</sub> (control) viz., without adding pearl millet. The fish were fed at a rate of 3% of their body weight once a day. The pearl millet mixed feed has not shown any detrimental effects on the fish survival, growth, and water quality parameters. The maximum net weight gain was 23.60±0.15 g noticed in T<sub>4</sub> at 24% inclusion of pearl millet, and the lowest was (21.43±0.03 g) in T<sub>0</sub> (control). The in this treatment level (T<sub>4</sub>) the highest percent weight gain (54.89±0.34%). The lowest FCR (2.70±0.01). The maximum SGR (0.98±0.003%). However, the maximum GCE was noted in T<sub>2</sub> (0.36±0.003) compared to minimum (0.35±0.001) value in T<sub>0</sub> (control). Including of pearl millet at 24% inclusive level & equally replacing the rice bran gave with apparent protein digestibility in common carp.

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

### Introduction

The fishing sector in India contributes significantly to the country's economy. In 2022, a total of 178 MMT of fish aquatic mammals, and reptiles and 36 MMT of algae were produced worldwide, with 88% of this produce being consumed by people. This output resulted in a high per capita intake of 20.2 kg of fish in developing countries. In 2022, capture fisheries produced 90.3 MMT. 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 the Fisheries sector in the 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 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 millet). The majority of India's millet production is made up of sorghum (Jowar) and pearl millet (Bajra). It has grown throughout Africa and the Indian subcontinent from 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) [5]. 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). In Rajasthan, an area of 43,483,396 hectares 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) [6].

The objectives of research in aquaculture as a developing sector are how focused 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”.

### Materials and Methods

This study was conducted at the aquaculture laboratory of the Department for a period of 60 days in 18 plastic tanks with 225 liters 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 of homogenies size group were placed in circular FRP tanks to acclimatise for a week. Proper aeration and a basal diet were provided during the acclimatisation phase.

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 following Sharma *et al.*, (2021)<sup>[9]</sup>. 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 *viz.*, T<sub>1</sub> (06%), T<sub>2</sub> (12%), T<sub>3</sub> (18%), T<sub>4</sub> (24%), and T<sub>5</sub> (30%). T<sub>0</sub> (control), *i.e.*, without adding pearl millet. The fish were fed at a rate of 3% of their body weight once in a day.

Growth response of *Cyprinus carpio* var. *communis*

fingerlings as measured by net weight gain (NWG), percent weight gain (%WG), specific growth rate (SGR), feed conversion ratio (FCR), and gross conversion efficiency (GCE).

Managing congenial water quality is essential for a profitable fish rearing. For the present experiment groundwater was used. Selected water quality parameters, including water temperature (°C), air temperature (°C), pH, dissolved oxygen (mg/l), total alkalinity (mg/l), total hardness (mg/l), electrical conductivity (µS/cm<sup>-1</sup>), nitrate (mg/l), and orthophosphate (mg/l) were measured According to the APHA's standard methodology from 2005.

### Results and Discussion

#### Water quality parameters

In fish culture, water quality is typically assessed as an important reference data to assertion that water is being suitable for fish growth and survival other. The range fluctuate between during experimental air temperature between minimum 27.2 to maximum 29.2 °C, water temperature were 26.1 °C to 28.4 °C. The electrical conductivity were 160 to 192 µS/cm<sup>-1</sup>. The pH were 7.1 to 8.30. The dissolved oxygen were 6.1 to 8.0 mg/l. The total alkalinity were 106 to 151 mg/l. The total hardness were 420 to 496 mg/l. The nitrate were 0.021 to 0.089 mg/l. The orthophosphate were 0.41 to 0.88 mg/l respectively show in Nigam *et al.* (2023)<sup>[7]</sup> described in Table 1.

**Table 1:** Range of water quality parameters during the experimental period in different treatments

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

#### Growth performance

After 60 days, when the study was terminated, the growth performance of common carp (*Cyprinus carpio*) was assessed for experimental diets that substituted rice bran in varying amounts, *i.e.*, 6%, 12%, 18%, 24%, and 30%. Using various levels of pearl millet replacing equal amounts of rice bran fish diet. The pearl millet mixed feed has not shown any detrimental effects on the fish survival, growth, and water quality parameters. The maximum net weight gain was

23.60±0.15 g noticed in T<sub>4</sub> at 24% inclusion of pearl millet, and the lowest was (21.43±0.03 g) in T<sub>0</sub> (control). The in this treatment level (T<sub>4</sub>) the highest percent weight gain (54.89±0.34%). The lowest FCR (2.70±0.01). The maximum SGR (0.98±0.003%). However, the maximum GCE was noted in T<sub>2</sub> (0.36±0.003) compared to minimum (0.35±0.001) value in T<sub>0</sub> (control) following standard methods provide the fish growth parameters described in Table 2 and Figure 1.

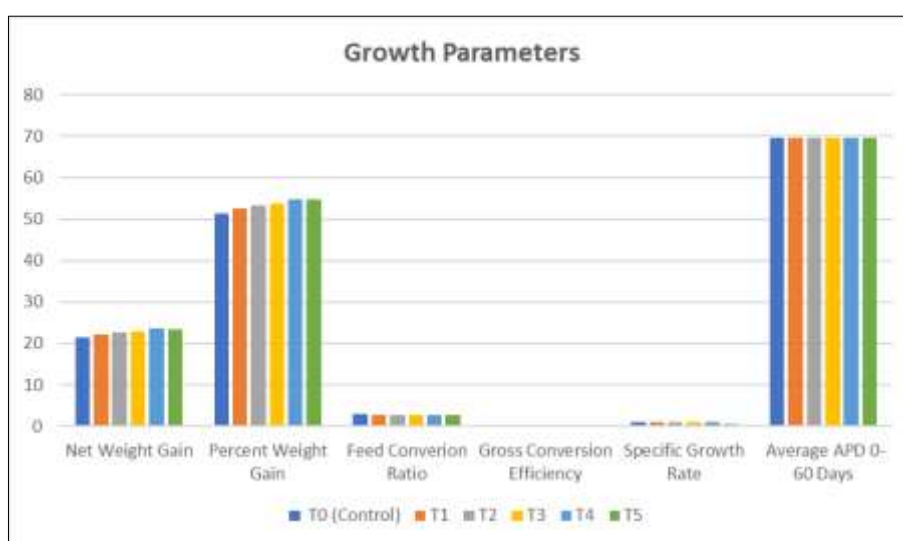
**Table 2:** Summary of growth parameters of *Cyprinus carpio* fed with different levels of pearl millet mixed feed in different treatments

Treatments	Net weight gain (g)	Percent weight gain	FCR	GCE	SGR	APD Avg 0-60 days
T <sub>0</sub> (Control)	21.43 <sup>a</sup> ±0.03	51.39 <sup>a</sup> ±0.23	2.86 <sup>d</sup> ±0.01	0.35 <sup>a</sup> ±0.001	0.92±0.002	69.50±0.19
T <sub>1</sub>	22.16 <sup>b</sup> ±0.14	52.56 <sup>ab</sup> ±0.40	2.80 <sup>c</sup> ±0.01	0.36 <sup>bc</sup> ±0.001	0.94±0.002	69.50±0.26
T <sub>2</sub>	22.62 <sup>bc</sup> ±0.13	53.29 <sup>bc</sup> ±0.18	2.77 <sup>bc</sup> ±0.02	0.36 <sup>c</sup> ±0.003	0.95±0.004	69.52±0.49
T <sub>3</sub>	22.95 <sup>cd</sup> ±0.13	53.86 <sup>abc</sup> ±0.24	2.75 <sup>b</sup> ±0.01	0.36 <sup>b</sup> ±0.002	0.96±0.003	69.52±0.31
T <sub>4</sub>	23.60 <sup>c</sup> ±0.15	54.89 <sup>d</sup> ±0.34	2.70 <sup>a</sup> ±0.01	0.36 <sup>bc</sup> ±0.002	0.98±0.003	69.55±0.36
T <sub>5</sub>	23.48 <sup>de</sup> ±0.33	54.65 <sup>cd</sup> ±0.86	2.73 <sup>ab</sup> ±0.02	0.36 <sup>bc</sup> ±0.002	0.98±0.004	69.58±0.42
P value	<0.001	0.001	<0.001	0.002	0.447	1.000
SEm ±	0.148	0.429	0.010	0.001	0.002	0.255
CD at 5%	0.455	1.321	0.032	0.004	0.007	NS
CV (%)	1.13	1.39	0.65	0.60	0.67	0.63

Data are expressed as mean± S.E, n=3, mean value in the same column with different superscripts differ significantly (p<0.05).

T<sub>0</sub>- fingerlings feeding of control diet with 0% pearl millet, T<sub>1</sub>- Feeding of control diet with 6% pearl millet replaced by

rice bran, T<sub>2</sub>- Feeding of control diet with 12% pearl millet replaced by rice bran, T<sub>3</sub>- Feeding of control diet with 18% pearl millet replaced by rice bran, T<sub>4</sub>- Feeding of control diet with 24% pearl millet replaced by rice bran, T<sub>5</sub>- Feeding of control diet with 30% pearl millet replaced by rice bran.



**Fig 2:** of growth parameters and apparent protein digestibility of

**Cyprinus carpio fingerlings**

The highest apparent protein digestibility level of 69.58±0.42 was observed in T<sub>5</sub>, followed by 69.55±0.36 in T<sub>4</sub>, 69.52±0.31 in T<sub>3</sub>, 69.52±0.31 in T<sub>2</sub>, 69.50±0.26 in T<sub>1</sub> and lowest 69.50±0.19 in T<sub>0</sub>. The statistical analysis was conducted for

the apparent protein digestibility. It indicates a non-significant difference between all treatments. However, the growth of common carp was significant between, T<sub>0</sub> and T<sub>5</sub> in 0-60 days described in Tables 3 and Figure 2.

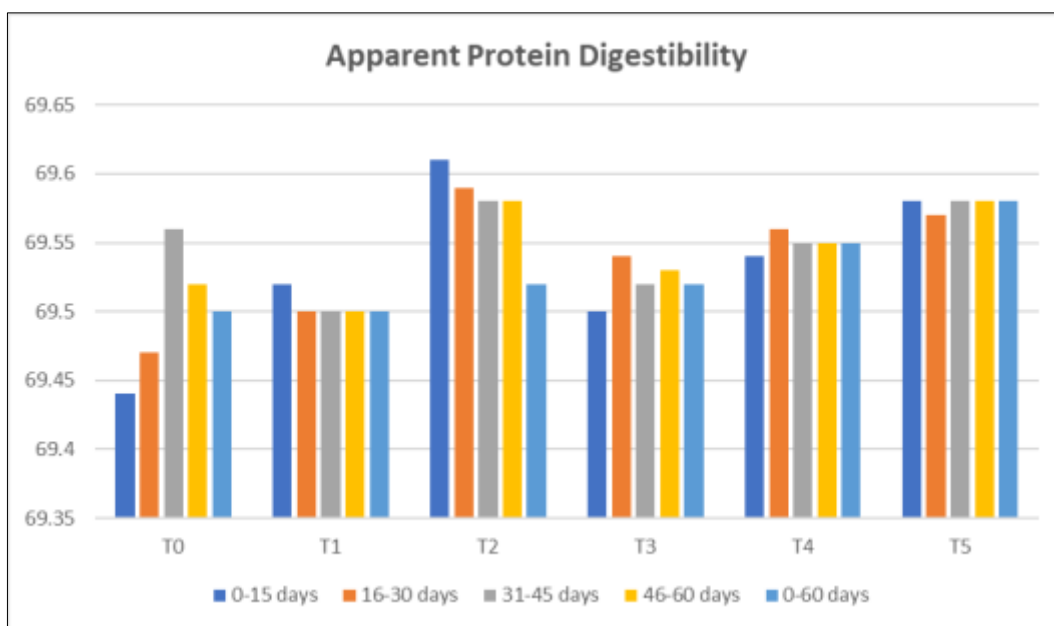
**Table 3:** Apparent Protein Digestibility of *Cyprinus carpio* fed with different levels of pearl millet mixed feed in different treatments

Treatments	Apparent Protein Digestibility				
	0-15 days	16-30 days	31-45 days	46-60 days	APD Avg 0-60 days
T <sub>0</sub> (Control)	69.44±0.42	69.47±0.44	69.56±0.44	69.52±1.71	69.50±0.19
T <sub>1</sub>	69.52±0.44	69.50±0.66	69.50±0.66	69.50±0.44	69.50±0.26
T <sub>2</sub>	69.61±0.67	69.59±0.37	69.58±0.37	69.58±0.50	69.52±0.49
T <sub>3</sub>	69.50±0.37	69.54±0.48	69.52±0.48	69.53±0.37	69.52±0.31
T <sub>4</sub>	69.54±0.58	69.56±0.60	69.55±0.60	69.55±0.48	69.55±0.36
T <sub>5</sub>	69.58±0.60	69.57±1.44	69.58±1.44	69.58±0.60	69.58±0.42
P Value	1.000	1.000	1.000	1.000	1.000
SEm ±	0.492	0.689	0.689	0.76	0.255
CD at 5%	NS	NS	NS	NS	NS
CV (%)	1.23	1.72	1.72	1.89	0.63

Data are expressed as mean± S.E, n=3, mean value in the same column with different superscripts differ significantly (p<0.05).

T<sub>0</sub>- fingerlings feeding of control diet with 0% pearl millet, T<sub>1</sub>- Feeding of control diet with 6% pearl millet replaced by

rice bran, T<sub>2</sub>- Feeding of control diet with 12% pearl millet replaced by rice bran, T<sub>3</sub>- Feeding of control diet with 18% pearl millet replaced by rice bran, T<sub>4</sub>- Feeding of control diet with 24% pearl millet replaced by rice bran, T<sub>5</sub>- Feeding of control diet with 30% pearl millet replaced by rice bran.



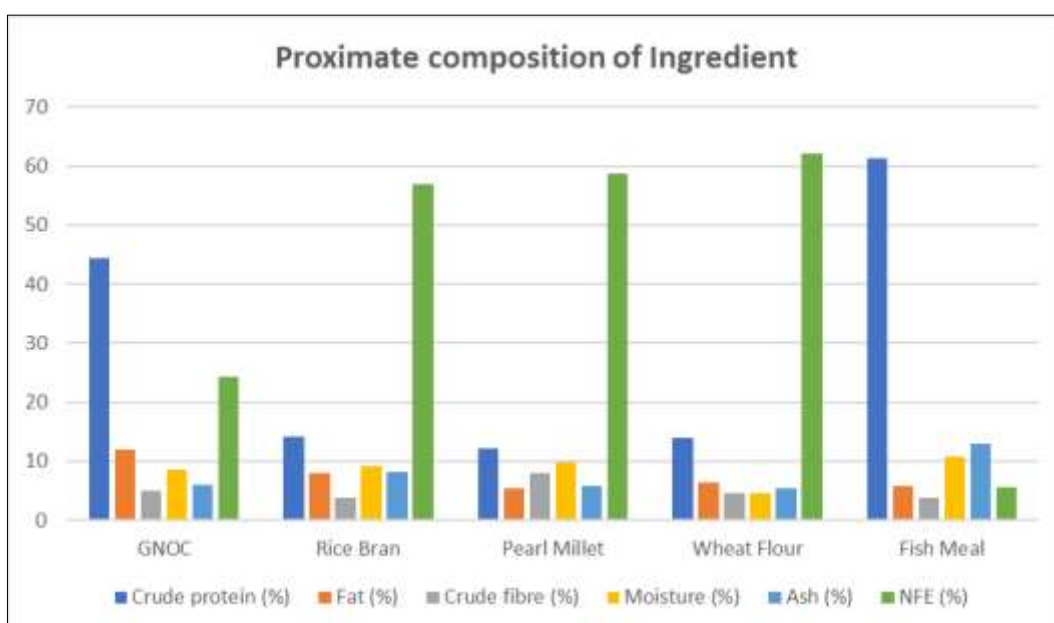
**Fig 2:** Apparent Protein Digestibility (APD) of *Cyprinus carpio* fingerlings in different treatments

The highest content of crude protein ( $61.290 \pm 0.421\%$ ) was found in fish meal, and the lowest ( $12.240 \pm 0.117\%$ ) was found in pearl millet. The highest level of fat (lipid) ( $12.000 \pm 0.076\%$ ) was observed in GNOC, and the lowest ( $5.400 \pm 0.028\%$ ) was found in pearl millet. The highest ash ( $12.860 \pm 0.088\%$ ) was noticed in fish meal, and the lowest level of ash ( $5.400 \pm 0.028\%$ ) was seen in wheat flour. The highest fiber content ( $8.040 \pm 0.042\%$ ) was noticed in pearl millet and the lowest ( $3.710 \pm 0.032\%$ ) in fish meal. The

highest moisture ( $10.800 \pm 0.093\%$ ) was noticed in the fish meal and the lowest ( $4.530 \pm 0.031\%$ ) in wheat flour. The maximum nitrogen-free extract (NFE) was noticed ( $62.170 \pm 0.44\%$ ) in wheat flour and the lowest ( $5.560 \pm 0.04\%$ ) describe in Table 4 and Figure 3. Boscolo *et al.*, (2010) [4] assessed the addition of pearl millet to meals for sexually reverted Nile tilapia fingerlings that contained 30% digestible protein and 3,000 kcal/kg of digestible energy.

**Table 4:** Proximate composition of ingredient used in fish feed

Ingredients	Crude protein (%)	Fat (%)	Crude fibre	Moisture (%)	Ash (%)	NFE (%)
GNOC	$44.380 \pm 0.269$	$12.000 \pm 0.076$	$4.900 \pm 0.031$	$8.466 \pm 0.053$	$6.03 \pm 0.148$	$24.224 \pm 0.153$
Rice Bran	$14.144 \pm 0.089$	$8.020 \pm 0.077$	$3.810 \pm 0.036$	$9.070 \pm 0.087$	$8.100 \pm 0.051$	$56.856 \pm 0.544$
Pearl Millet	$12.240 \pm 0.117$	$5.400 \pm 0.028$	$8.040 \pm 0.042$	$9.830 \pm 0.052$	$5.800 \pm 0.056$	$58.690 \pm 0.309$
Wheat Flour	$14.010 \pm 0.074$	$6.290 \pm 0.043$	$4.600 \pm 0.032$	$4.530 \pm 0.031$	$5.400 \pm 0.028$	$62.170 \pm 0.448$
Fish meal	$61.290 \pm 0.421$	$5.780 \pm 0.050$	$3.710 \pm 0.032$	$10.800 \pm 0.093$	$12.860 \pm 0.088$	$5.560 \pm 0.048$



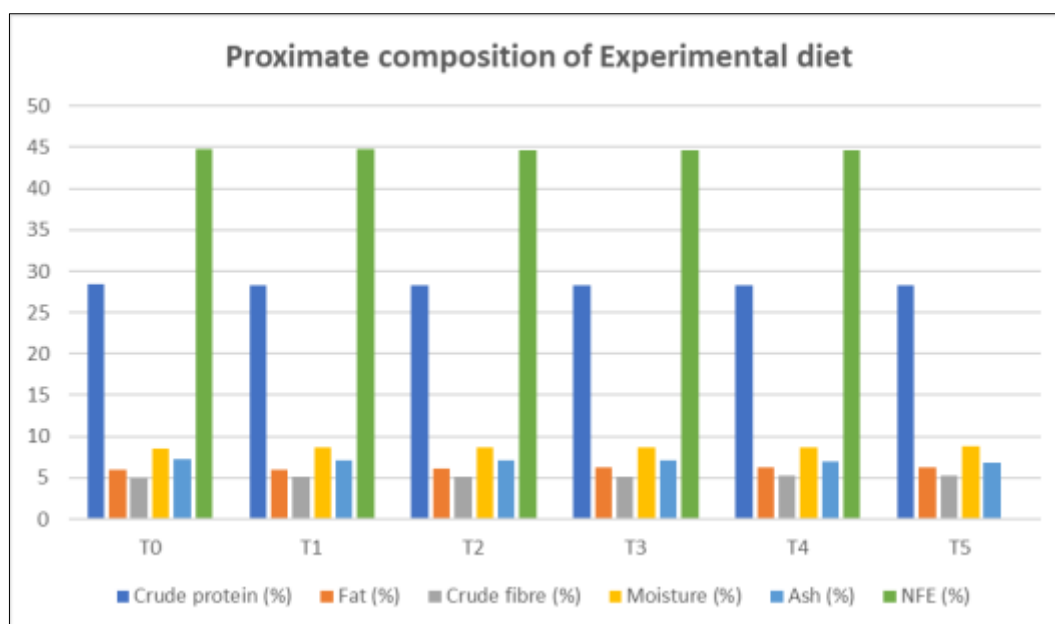
**Fig 3:** Proximate composition of ingredients

The highest level of crude protein ( $28.392\pm 0.172\%$ ) was found in T<sub>0</sub>, while lowest ( $28.240\pm 0.243\%$ ) was found in T<sub>5</sub>. The maximum percent of fat (lipid) ( $6.270\pm 0.130\%$ ) was found in T<sub>5</sub>, and the lowest ( $5.980\pm 0.038\%$ ) was found in T<sub>0</sub>. The maximum percent of crude fiber was ( $5.310\pm 0.1100\%$ ), and the minimum ( $5.040\pm 0.032\%$ ) was found in T<sub>5</sub> and T<sub>0</sub>. The maximum percent of moisture ( $8.800\pm 0.182\%$ ) was found in T<sub>5</sub>, and the minimum ( $8.590\pm 0.054\%$ ) was found in T<sub>0</sub>. The highest level of ash in the experimental diet ( $7.200\pm 0.177\%$ ) was noticed in T<sub>0</sub> and the lowest ash

( $6.860\pm 0.059\%$ ) was noticed in T<sub>5</sub>. The highest nitrogen-free extract ( $44.798\pm 0.282\%$ ) was seen in the T<sub>0</sub>, and the lowest was observed in T<sub>5</sub> ( $44.490\pm 0.919\%$ ) described in Table 5 and Figure 4. Sharma *et al.* (2023) [10] while using sorghum millet (jowar) supplementary diet on the growth and survival of *Oreochromis niloticus* (Nile Tilapia) fingerlings, concluded that 20% sorghum millet in diet can boost the growth of fish without any detrimental effects on fish health for the test fish during experimental period 100% survival rate was observed in test fish.

**Table 5:** Proximate composition of experimental diet in different treatments

Treatments	Crude protein (%)	Fat (%)	Crude fibre	Moisture (%)	Ash (%)	NFE (%)
T <sub>0</sub> (Control)	28.392±0.172	5.980±0.038	5.040±0.032	8.590±0.054	7.200±0.177	44.798±0.282
T <sub>1</sub>	28.340±0.178	6.040±0.058	5.060±0.048	8.620±0.082	7.160±0.045	44.780±0.429
T <sub>2</sub>	28.310±0.271	6.145±0.068	5.110±0.027	8.630±0.045	7.110±0.068	44.695±0.235
T <sub>3</sub>	28.290±0.149	6.190±0.043	5.180±0.126	8.710±0.060	7.040±0.037	44.590±0.306
T <sub>4</sub>	28.280±0.194	6.220±0.053	5.260±0.045	8.740±0.075	6.920±0.048	44.580±0.383
T <sub>5</sub>	28.240±0.243	6.270±0.130	5.310±0.110	8.800±0.182	6.860±0.059	44.490±0.919
SEm ±	0.200	0.0640	0.063	0.0867	0.0781	0.442
CD at 5%	NS	NS	NS	NS	NS	NS
CV (%)	1.22	1.80	2.13	1.73	1.92	1.71



**Fig 4:** Proximate composition of experimental diet of *Cyprinus carpio* fingerlings in different treatments

## Discussion

This finding is very much in consonance with 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 authors revealed that switching from corn to barley and millet caused a higher rate of weight gain in test fish. The results of present study also revealed that rice bran replacement, with pearl millet at the rate 24% has significantly increased fish growth. However, with further increase of pearl millet (30%) could not give significant results.

Olaniyi *et al.* (2007) [8] determined the replacement value of fermented millet for maize in the diets of *Clarias gariepinus* fingerlings reared in a recirculation system using 5 isonitrogenous formulated diets containing graded levels of

fermented millet meal replacing 0, 20, 40, 60, and 80% of maize. The result showed that the diets significant ( $p < 0.05$ ) affected fish performance. There was significant reduction in feed conversion ratio and nutrient utilisation efficiency with increasing fermented millet meals. However, the highest present weight gain and lowest feed conversion ratio were observed in fish feed a 20% replacement level, even though growth depression occurred with increasing dietary levels of fermented millet ( $p > 0.05$ ).

Boscolo *et al.*, (2010) [4] assessed the addition of pearl millet to meals for sexually reverted Nile tilapia fingerlings that contained 30% digestible protein and 3,000 kcal/kg of digestible energy. During the present study it was revealed that the growth performance that i.e., net weight gain and specific growth rate maximum in T<sub>4</sub> ( $26.260\pm 0.555$ ) and ( $0.985\pm 0.003$ ) respectively in with better feed conversion ratio ( $2.697\pm 0.014$ ) and gross conversion efficiency



( $0.361 \pm 0.002$ ) in T<sub>4</sub> with 24% replacement of rice bran with pearl millet. This finding is very much in consonance with Allameh *et al.*, (op.cit.) and Olaniyi *et al.*, (op. cit.). Since the fingerlings' performance was consistent across all rations, it was clear that energy levels had no impact on the traits of performance. The researchers found that pearl millet can be used in feeds for Nile tilapia fingerlings totally replacing the energy and protein of corn without effect on performance and carcass quality of the animals. The statistical analysis of growth parameter indicates significant difference ( $p < 0.05$ ) between all treatment compare to control. However, the growth of common carp was not significant between, T<sub>4</sub> and T<sub>5</sub> in 0-60 days.

Sharma *et al.* (2023) [10] while using sorghum millet (jowar) supplementary diet on growth and survival of *Oreochromis niloticus* (Nile Tilapia) fingerlings concluded that 20% sorghum millet in diet can boost growth of fish without any detrimental effects on fish health. As such adding of pearl millet in present study by replacing rice bran in supplementary feeding in common carp was found advantages is obtaining better fish growth performance.

### Conclusion

Water quality factors are crucial for improving freshwater aquaculture productivity. It can be concluded from the present study that air and water temperature, EC, pH, DO, Total alkalinity, Total hardness, Nitrate, and Orthophosphate was found in the optimum range and did not show any adverse effect among all treatment on the fish growth. It is evident from the study and discussion that adding of replacing pearl millet with an equal amount of rice bran in experimental diets at the rates of 0%, 6%, 12%, 18%, 24%, and 30% has shown a significant increase in growth performance of the fish observed in terms of weight gain, percent weight gain, specific growth rate, feed conversion ratio, gross conversion efficiency ratio, and apparent protein digestibility and the aquaculture output in the diet of common carp fingerlings. However, adding pearl millet to fish at a rate of 24% gave the significantly better result of growth performance and apparent protein digestibility. Thus, it is recommended for use in aquaculture to enhance the growth performance of common carp fingerlings.

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