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Replacement of Rice Bran with Curry Leaves (*Murraya koenigii*) in the Diet of Nile Tilapia (*Oreochromis niloticus*)

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ABSTRACT: This study investigated the dietary substitution of rice bran with curry leaves (*Murraya koenigii*) in the feeding regimen of Nile tilapia (*Oreochromis niloticus*) over a 90-day experimental period. Four experimental diets were formulated with varying concentrations of curry leaves (0%, 33%, 66%, and 99%) replacing rice bran across three treatment groups and one control group. Growth performance metrics including weight gain, daily weight gain, specific growth rate, feed conversion ratio, protein efficiency ratio, and survival rate were assessed. Water quality parameters were monitored throughout the study period. Results showed that dietary inclusion of curry leaves significantly influenced growth performance parameters. Tilapia fed with 33% curry leaves (Treatment 1) exhibited the highest average weight gain (73.90±0.75 g), daily weight gain (0.82±0.008 g/day), and specific growth rate (1.38±0.01 %/day), with improved protein efficiency ratio (1.84±0.01) and comparable survival rates (80%) to the control group. Conversely, higher concentrations of curry leaves (66% and 99%) showed reduced growth performance and survival rates, indicating potential negative effects at higher inclusion levels.

Keywords: Curry leaves, Nile tilapia, Growth performance, Proximate composition, Water parameters.

INTRODUCTION

Fisheries and aquaculture hold significant importance in various aspects of human life, as a food source, nutrition in health, gives job and employment and a livelihood for almost 28 million fisherman and for the fish farmers at the leading level with nearly double that number engaged in the value chain. In production India stand in the third place for producing fish among other countries, about 16% in Inland of the total and 5% of the total marine globally for fish production respectively. In India fish production has maintained about 175.45 lakh tonnes during FY 2022-23 reaching with high production of all time. With the largest fish catches in 2022–2023, Andhra Pradesh, West Bengal, and Karnataka are India's top three fish-producing states. India is in the top 5 countries in the world for fish exports, coming in third place behind China and Indonesia. In the Indian economy, the fishing industry contributes roughly 1.1% of the total, while agriculture accounts for roughly 67.2%. The nation's seafood exports reached an all-time high of US$ 8.09 billion in 2022–2023 with 1.73 million MT (Handbook on fisheries statistics, 2023). A modest decline from the peak of 179 million metric tons in 2018 was predicted for the global production of aquatic animals in 2020, with an estimated 178 million metric tons produced worldwide. The two sectors made almost equal contributions: aquaculture contributed 88 million metric tons (49 %) and 51 percent, or 90 million metric tons, came from capture fisheries. Sixty-three percent, or 112 million metric tons, of the total production came from marine waters, with aquaculture accounting for thirty percent and capture fisheries for seventy percent. By contrast, 66 million metric tons, or 37 percent, were produced in inland waters, mostly from aquaculture (83 percent), with capture fisheries accounting for the remaining 17 percent. At USD 141 billion from capture fisheries and USD 265 billion from aquaculture, the estimated first-sale value of global production was $406 billion. In addition, 36 million metric tons (wet weight) of algae remained yielded in 2020 along with aquatic animals, with 97 percent of the algae coming from marine-based aquaculture (FAO, 2022).

Murraya koenigii, known as curry leaves in India, is prized for its culinary use and medicinal properties. It enriches Indian dishes with its unique flavor and is valued for treating various ailments. Curry leaves are packed with nutrients including carbohydrates, proteins, fibers, vitamins (B, C, A, E), and minerals like calcium, phosphorus, iron, magnesium, and copper. They also contain antioxidants, plant sterols, glycosides, and flavonoids. Extracted oil from curry leaves is applied externally for skin conditions and is used in soap and perfume production (Prajapati *et al*., 2003). Packed with a multitude of nutrients, including carbohydrates, fiber, calcium, phosphorus, iron, magnesium, zinc, multivitamins, and flavonoids, curry leaves offer a wealth of health benefits. They are extensively used in the treatment of anemia, diabetes, indigestion, obesity, kidney problems, and hair and skin issues. *M. koenigii* are rich in protein, fibre, calcium, also rich in phosphorus with abundance of essential oils (Nigam, 2023). The chemical composition of *M. koenigii* includes essential oils, alkaloids, and terpenoids (Jain *et al*., 2017). Additionally, terpene constituents such as citral, linalyl acetate, menthone, menthol, and carvomenthone, along with β-caryophyllene, contribute to its flavor (Chowdhury *et al*., 2000). Curry leaves are predominantly utilized as a vegetable and spice in soups, meat dishes, and various medicinal foods (Matsuda *et al*., 2009). Curry leaves exhibit tonic, antioxidant, antidiabetic, anticancer, antitumor, anticonvulsant, antiacne, anthelmintic, antipiles, analgesic, anti-inflammatory, antihypertensive properties, and are used in managing bronchial respiratory diseases (Shah and Juvekar 2006). It also demonstrates antibacterial activity against *S. typhi* and *E. coli* (Shivkanya *et al*., 2009).

The Nile tilapia (*Oreochromis niloticus*) is among the earliest fish species to have been cultured globally. Evidence from Egyptian tombs suggests that Nile tilapias were cultivated over 4,000 years ago, predating the introduction of carp farming in China by approximately 1,000 years (Balarin and Hatton 1979). Nile tilapia (*O. niloticus*) stands out as the most significant species among tilapia. Tilapias are highly adaptable to various environmental conditions, including water temperature, salinity, dissolved oxygen, and ammonia tolerance (El-Sayed, 2006). Tilapia often referred to as the 'aquatic chicken' because of its ability to thrive in challenging environments and its rapid growth rates, saw a 3.3% increase in global production in 2020, reaching 6 million tonnes, even amid the disruptions caused by COVID-19 (Fletcher, 2020). Besides, tilapias are fast-growing with firm, white flesh, capable of surviving in poor water conditions, consuming a wide range of food types, and breeding easily without requiring special hatchery technology (Nandlal and Pickering 2004). The rapid growth in the aquaculture sector is challenged by numerous endemic and emerging diseases, including hepatopancreatic necrosis disease and tilapia lake virus (Bacharach *et al*., 2016; Senapin *et al*., 2018).

MATERIALS AND METHOD

Experiment Site: Sarma Fish Breeding Farm: Situated in Gandatwisa, Dhalai, approximately 115 kilometers from Agartala, the farm was founded in 1980 and is run by TTAADC in Khumulung, West Tripura. Nestled within the farm are four hatcheries for Eco-carp, Magur and Singhi, Pangasius, and Tengara species, all overseen by the Superintendent of Fisheries. It looks after seventy-five ponds for brood stock, culture, rearing, and nursing, among other aquaculture activities. With its state-of-the-art water quality testing facilities, training hall, and hostel, the farm instructs more than 2000 farmers each year, greatly improving aquaculture methods in the area. Its breeding program concentrates on a wide variety of species. The farm is essential to the fishery because it is located near the Saima River, which empties into Dumboor Lake and forms the Gomati River. In addition to overseeing pond water quality and managing Dumboor Lake operations, the office of the Superintendent of Fisheries is responsible for offering farmers thorough training.

Fig. 1. Map showing the study area of (Sarma fish breeding farm, gandatwisa, dhalai Tripura).

Procurement of (*O. niloticus*) Fingerlings. The fingerling of tilapia (*Oreochromis niloticus)* was collected from the Gandatwisa farm itself about 150 in total for the experiment. The local farm farmers did net in the pond for collecting tilapia fingerlings. The fish were then disinfected with NaCl and KMnO4 before stocking in control and treatment tank. The fingerlings were kept for acclimatization for three days. Out of 150 healthy disease-free fingerlings were selected for stocking 10 fingerlings in each tank.

Collection of Ingredients. The Curry leaves (*Murraya koenigii*) was collected from my house garden and neighbour household. After the curry leaves are collected it was sun-dried for complete 11 days until the leaves are completely dried out with zero moisture contain in it. After the leaves were powdered and kept in an air tight plastic packet. All the other ingredients used in the feed making (rice bran, MOC, wheat flour, soy bean meal, fish meal) and the vitamin capsule were collected from the local Gandacherra market. Apart from the vitamin capsule all other ingredients are sun dried for 2 days and powdered and kept in an air tight packet.

Diet Formulation. The pears on square method was used for the making of feed. All the ingredients were finely powdered all of it are mixed all together according to the percentage amount calculation of the ingredient with water, vitamin was added in all the three feeds including the control tank. The feed was formulated with 40% protein content by (1/3) that is 33%, 66% and 99% of curry leaves replacing rice bran. After complete mixing the dough feed were put in a feed pelletizer and extruded according to the required size for the fingerling fish mouth. Extruded pelleted feed are then dried on an aluminium foil until the feed moisture content is below 10%. The control feed used contains 0% curry leaves, for the three treatment tanks, three different percentages of curry leaves are used to prepare the other three experimental diets. For the control experiment, feed containing soy bean, wheat flour, mustard oil cake (MOC) and fish meal as the ingredients was used.

Experimental Design. The experiment was led for complete 90 days, for the experiment total 12 tanks were used with one control and three treatments with three replicas for each treatment, in the control tank 0% of curry leaves were fed with 33% of curry leaves in (T1) tank, 66% of curry leaves in (T2), and 99% of curry leaves in (T3). For the control tank feed was different with no use of curry leaves or rice bran, in the other three treatment (T1), treatment (T2) and treatment (T3) all the ingredients used in the control were included except for the Soy bean. Twice daily, in the morning and evening, the fish was fed @ 5% of the body weight. The water holding capacity of tank is 200L with 1 diameter area. Before the fingerlings were stocked the tanks were disinfected properly with the use of potassium permanganate solution (Kmn04) and NaCl washing the tanks after with normal water again then full the tank with water and kept for one day to avoid any effect on the fish before stocking. The water source for the experiment was taken from water pump for the whole experiment process. The tank was then filled with water all of 12 tanks then the fingerlings were stocked measuring the weight and length 10 fingerlings in each tank. Aeration was provided in all 12 tanks to maintain the water oxygen level to avoid any stress to the fish. The feed was fed every morning and evening 5% of the body weight. Water parameters was checked every after 15 days as well the weight of the fish.

Water Parameters. The water was analysed every after 15 days to check the below listed parameters, with the use of API test kit for (pH and ammonia) and for dissolve oxygen (D.O.) Winklers method for alkalinity titration method was used.

Growth Parameters. The following formulas were used to calculate the fish's growth performance.

— Total gain (g $fish^{-1}$) = (WT - WI), where WT is the final weight of fish in grams and WI is the initial weight of fish in grams.

— The average daily gain (ADG) (g $fish^{-1}$ day^{-1}) = total gain/experimental days.

— The specific growth rate (SGR) (% day^{-1}) = 100 × (ln WT - ln WI)/duration/day.

— The feed conversion ratio (FCR) = total feed intake (g)/total gain (g).

— The protein efficiency ratio (PER) = total gain (g)/protein intake (g).

— Survival percentage = (number of fish in each group remaining after the 90 days feeding period/initial number of fish) × 100. The total weight of surviving fish was recorded.

Statistical Data Analysis. The growth performance metrics, including mean weight gain(g), daily weight gain, specific growth rate (SGR), feed conversion ratio (FCR),and Protein efficiency ratio (PER)were identifiedtheir significant differences among the groups. The data obtained from this study were analysed using the Statistical Package for the Social Sciences (SPSS). To compare the treatment effects, Duncan's post-hoc test was applied, and the data were presented as mean ± SE. Results will be considered statistically significant at the 5% level ($p < 0.05$).

RESULT

The effects of adding curry leaves (*M. koenigii*) to Nile tilapia (*O. niloticus*) diet are thoroughly examined in this chapter, resulting in progressive weight gain across all treatments throughout the study duration. By incorporating (*M. koenigii*) powder at various concentrations and feeding it at 5% of the body weight, the study observes continuous weight gain across all treatments. Additionally, monitoring of physiochemical parameters such as temperature, ammonia, pH, DO, and alkalinity, water was conducted throughout the study. Furthermore, measures were taken to address initial fish mortality in the control and T2 tank. The chapter also presents detailed data on the initial weight, final weight, weight gain, and various growth performance parameters of (*O. niloticus*) fed these diets, beside growth performance analyzed by weighing the tilapia at regular 15-day intervals.

The growth parameters in the current study were recorded every two weeks. The fish were not fed on the day of the sampling. Following sampling, the following metrics were calculated: weight gain (WG), average daily weight gain (ADWG), specific growth rate (SGR), feed conversion ratio (FCR) and Protein efficiency ratio (PER). The fish's final average body weights varied from (84.35±3.008 g to 103.79±0.94 g), while their initial average weights ranged from (29.89±0.37 g to 33.25±0.63 g).

The growth of Nile tilapia in terms of weight gain (g), average weight gain (g), specific growth rate, feed conversion ratio (g), and protein efficiency ratio (g) at the end of the 90-day experimental feeding trial varied significant ($p<0.05$) among the different experimental diets.

Table 1: Ingredient composition percentage (%) of diets with varying levels of curry leaves for different treatments (0 % in control, 33 % in treatment 1, 66 % in treatment 2, 99 % in treatment 3).

	Treatment			
Ingredients	**C (0%)**	**T1(33%)**	**T2(66%)**	**T3(99%)**
Curry leaves	0	4.51	9.03	13.55
Rice bran	0	9.18	4.66	0.14
MOC (mustard oil cake)	20	36.3	36.3	36.3
Fish meal	20.25	36.3	36.3	36.3
Wheat flour	25.52	13.69	13.69	13.69
Soybean	37.32	0	0	0
Vitamin and minerals	1	1	1	1

Table 2: **Average water quality parameters of different experimental treatments.**

	Treatment			
Parameters	**C**	**T1**	**T2**	**T3**
Temperature (°C)	23.4-25.6 24.5	22.4-25.2 23.8	23.1-24.6 23.85	23.6-25.8 24.7
pH	7.3±7.9 7.6	7.2-7.8 7.5	7.6-8.0 7.8	7.4-8.0 7.7
D.O (mg/L)	6.82-7.20 7.01	6.84-7.44 7.14	5.93-6.21 6.07	5.88-6.70 6.29
Alkalinity (mg/L)	73-92 82.5	90-116 103	88-120 104	86-118 102
Ammonia (ppm)	0.06+0.09 0.07	0.06+0.07 0.06	0.06+0.09 0.07	0.06+0.07 0.06

Table 3: Proximate composition percentage (%) of diets with varying levels of curry leaves.

Proximate Composition				
Moisture	9.1	7.2	7.5	7.3
Crude protein	38.81	38.7	37.36	37.83
Fat	8.62	8.24	8.53	8.21
Ash	7.6	8.02	8.05	8.03
Fibre	8.84	9.03	8.32	8.44
Nitrogen free-extract (NFE)	27.03	28.81	30.24	30.19

Table 4: Table: Average data of 15 days growth parameters of *O. niloticus* fingerlings during a 90-day experimental period under different dietary treatments with varying levels of curry leaves.

Growth parameters	**Treatments**			
	C	**T1**	**T2**	**T3**
Weight gain	10.76 ± 0.20^{b}	12.31 ± 0.12^{a}	8.84 ± 0.60^{c}	9.51 ± 0.06^{c}
Daily weight gain	0.71 ± 0.01^{b}	0.82 ± 0.008^{a}	0.58 ± 0.04^{c}	0.63 ± 0.004^{c}
Specific growth rate	1.25 ± 0.02^{b}	1.38 ± 0.01^{a}	1.10 ± 0.06^{c}	1.11 ± 0.01^{c}
Feed conversion ration	3.95 ± 0.15^{bc}	3.60 ± 0.07^{c}	4.41 ± 0.22^{ab}	4.51 ± 0.10^{a}
Protein efficiency ratio	0.26 ± 0.005^{b}	0.30 ± 0.003^{a}	0.22 ± 0.01^{c}	0.23 ± 0.001^{c}
Survival (%)	80 %	80 %	70 %	70 %

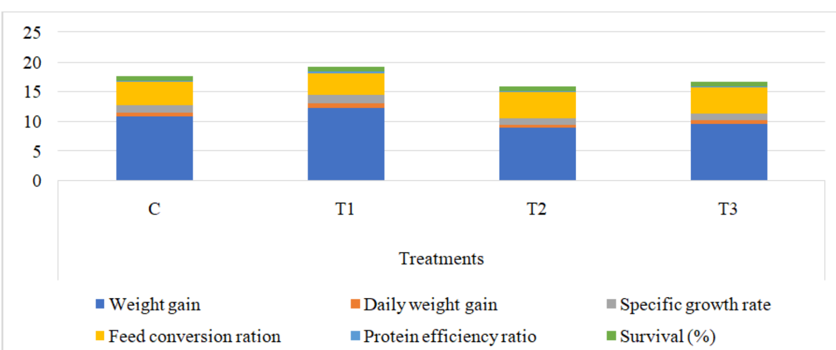

Fig. 2. Average data of 15 days for various growth performance indicators (wg, dwg, sgr, fcr, per and survival percentage) of Nile tilapia over a 90-day experimental period. the treatments include a control diet (c), and diets with varying levels of (*Murraya koenigii*) (t1, t2, t3) replacing rice bran.

Weight Gain. In this study the findings of the body weight of *O. niloticus*, observed is given in a table. The average body weight gains in 90 days for the control diet (C), treatment (T1), treatment (T2) and treatment (T3) were (64.58±1.21), (73.90±0.75), (53.05±3.61) and (57.08±0.36), respectively. With minimum in (T2) with an average gain of (53.05±3.61) grams and maximum in (T1) with an average gain of (73.90±0.75) grams. Treatment (T2) diet resulted in the least average weight gain among the treatments with treatment (T1) was the most effective in promoting weight gain.

Daily Weight Gain. The data provided outlines the average body weight gains (in grams) over the 90 experimental days for a control diet (C) and three treatments (T1, T2, T3) and it is presented in a table. In 90 days of experiment the average daily weight gain in the experiment tanks were in C (0.71±0.01), T1 (0.82±0.008), T2 (0.58±0.04) and T3 (0.63±0.004) with minimum in treatment (T2) with an average gain of (0.58±0.04) grams and maximum in treatment (T1) with an average gain of (0.82±0.008) grams. Treatment (T1) is the most effective in promoting body weight gain over the 90-day period, especially in the last 30 days.

Specific Growth Rate (SGR). The data provided represents the average body weight gains (in grams) for a control diet (C) and three treatments (T1, T2, T3) it is given in a table. The average specific growth rate (SGR) in 90 days of the four experimental tanks were in control (C) (1.25±0.02) treatment (T1) (1.38±0.01) treatment (T2) (1.10±0.06) and treatment (T3) (1.11±0.01) with minimum in treatment (T2) with an average of (1.10±0.06) and maximum in (T1) with an average of (1.38±0.01).

Feed Conversion Ratio (FCR). The data provided shows the average Feed conversion ratio (FCR) for different treatments over specific time periods presented in the table. The data presents the weight gains (in grams) across different treatments over specified time periods. The average Feed conversion ratio (FCR) in 90 days for the control diet (C), treatment (T1), treatment (T2) and treatment (T3) were (3.90±0.10), (3.45±0.05), (4.40±0.25) and (4.34±0.09), respectively with minimum in (T1) (3.45±0.05) and maximum in (T2) (4.40±0.24). Treatment (T2) shows a steady increase in (FCR), indicating decreasing efficiency in feed conversion over time, with a slight improvement at the end. (Treatment T1) Shows good initial efficiency, with a low (FCR) that increases significantly at mid-study before improving again, suggesting variable feed conversion efficiency. Treatment (T1) had a moderate FCR) among the four treatments. As the experiment was conducted during winter, the FCR value is not considered significant.

Protein efficiency ratio (PER). In 90 days of experiment the average protein efficiency ratio in the experiment tanks were in C (1.61±0.03), T1 (1.84±0.01), T2 (1.32±0.09) and T3 (1.42±0.009) with minimum in treatment (T2) with an average gain of (1.32±0.09) grams and maximum in treatment (T1) with an average gain of (1.84±0.01) grams.

Survivability. The survival rate results for *O. niloticus* fingerlings over a 90-day experimental period with varying levels of curry leaves in their diet are as follows: In the control and three treatments(C) 80%, (T1) 80%, (T2) 70% (T3) 70%. The control group (C) and T1 both had the highest survival rates at 80%. T2 and T3 had lower survival rates at 70%, indicating a 10% decrease compared to the control and T1. Overall, the survival rates were highest in the control group and the treatment with 33% curry leaves (T1), while the treatments with higher levels of curry leaves (T2 and T3) had slightly lower survival rates.

DISCUSSION

The findings indicate that the growth of tilapia decreases with an increase in water pH. These findings corroborated with the conclusions of Saber *et al*. (2004); Willingham *et al*. (2004); Scott *et al*. (2005) who similarly observed a decrease in mean weight gain with increasing pH, with a notable decline observed specifically. The consequences of this study indicate that the average daily body weight gain of tilapia at various pH levels varies significantly. Alike results were testified by Scott *et al*. (2005); Xu *et al*. (2005). Who found that the gain per fish per day decreased as the pH value increased. In this study, the treatments with the highest body weight gains were in T1 and control, respectively. The highest weight gain was observed in treatment T1 (73.90±0.75 g), followed by the control (64.58±1.21 g), T3 (57.08±0.36 g), and T2 (53.05±3.61 g). Similarly, the highest daily weight gain was also recorded in T1 (0.82±0.008 g/day), suggesting that a moderate inclusion of curry leaves can enhance growth performance. This result aligns with the findings of El-Sayed (2006), who noted that Nile tilapia can thrive on a variety of diets, which includes plant-based ingredients. The specific growth rate was highest in T1 (1.38±0.01 %/day), followed by the control (1.25±0.02 %/day), T3 (1.11±0.01 %/day), and T2 (1.10±0.06 %/day). The positive effect on SGR at moderate curry leaf inclusion is consistent with Nandlal and Pickering (2004), who reported that Nile tilapia's adaptability to diverse diets can lead to efficient growth rates. The feed conversion ratio was most efficient in T1 (3.45±0.05), compared to the control (3.90±0.10), indicating better feed utilization when curry leaves replaced part of the rice bran. This is comparable to the study by Nandlal and Pickering (2004), which emphasized tilapia's ability to efficiently convert a wide range of feed types into biomass. The protein efficiency ratio was highest in T1 (1.84±0.01), followed by the control (1.61±0.03). This improvement in PER with curry leaf inclusion aligns with research by Bacharach *et al*. (2016), who observed that certain plant-based additives could enhance protein utilization in aquaculture diets. The survival rate was highest in the control and T1 (80%) and lowest in T2 and T3 (70%). This indicates that while moderate inclusion of curry leaves does not adversely affect survival, higher inclusion rates might have some negative impacts. This is in line with the findings of Senapin *et al*. (2018), who noted that dietary changes could influence survival rates depending on the composition and inclusion levels. The observed growth performance parameters in this study are generally consistent with other research on dietary modifications in tilapia aquaculture. For instance, Fitzsimmons *et al*. (2011), emphasized the role of diversified diets in optimizing tilapia growth performance. The use of curry leaves, similar to other plant-based ingredients, can provide necessary nutrients while potentially offering additional health benefits. Moreover, the study by Saber *et al*. (2004), highlighted that specific dietary components can influence weight gain and growth rates. The inclusion of curry leaves, known for their nutritional and medicinal properties (Shah and Juvekar 2006), likely contributed to the improved growth metrics observed in T1.

In the proximate composition there is (Moisture, Crude protein, Fat, Ash, Fibre and (NFE) Nitrogen-free extract. Moisture: Shows the percentage of water content in each feed formulation. rude Protein: Indicates the percentage of protein in each formulation. Fat: Shows the percentage of fat or lipid content. Ash: Represents the mineral content after complete combustion. Fibre: Indicates the crude fibre content. NFE (Nitrogen-Free Extract): Represents the carbohydrates, available for energy. The reduction in moisture content with the inclusion of curry leaves may be attributed to the drying process of the leaves before incorporation into the diet. Similar results were reported by Aderolu and Sogbesan (2010), who found that plant-based ingredients can reduce the moisture content in fish diets due to their inherent lower moisture levels. The slight reduction in crude protein content in treatments T2 and T3 suggests that higher inclusion levels of curry leaves may dilute the protein content slightly. This is consistent with the findings of El-Sayed (2006), who noted that while plant-based ingredients can be nutritious, their protein content can vary and sometimes be lower than traditional fish meal. The minor variations in fat content across treatments suggest that curry leaves do not significantly affect the lipid composition of the diet. This aligns with the study by Nandlal and Pickering (2004), which found that plant-based diets can maintain lipid levels similar to traditional diets. The increase in ash content in all treatments with curry leaves is indicative of the mineral content present in the leaves. Curry leaves are known to be rich in minerals, which is reflected in the ash content of the diet. This finding is supported by Shah and Juvekar (2006), who highlighted the high mineral content in various medicinal plants. The increase in fibre content in T1 and T3 indicates that curry leaves are a good source of dietary fibre. High dietary fibre can aid in digestion and overall gut health, as noted by Bacharach *et al*. (2016), in their study on the benefits of plant-based fibres in fish diets. The increase in NFE in all treatments with curry leaves suggests that these leaves contribute to the carbohydrate fraction of the diet. This is important for providing energy to the fish, as highlighted by Senapin *et al*. (2018), who emphasized the role of carbohydrates in fish growth and metabolism. The inclusion of curry leaves in the diet of Nile tilapia shows promising results in terms of maintaining a balanced proximate composition. The increased ash and fibre contents are particularly beneficial, indicating a higher mineral and fibre intake, which can contribute to overall fish health. Further research could explore the optimal inclusion levels to maximize growth performance and health benefits.

CONCLUSIONS

In conclusion, dietary supplementation with curry leaves (*Murraya koenigii*) significantly influenced the growth performance of Nile tilapia (*Oreochromis niloticus*). Among the tested inclusion levels (0%, 33%, 66%, and 99%), the diet containing 33% curry leaves (T1) yielded the best growth outcomes, as evidenced by higher final weight, weight gain, and specific growth rate compared to other treatments. These results suggest that moderate inclusion of curry leaves in tilapia diets enhances growth without compromising survival rates, which remained consistently high across all dietary groups. These findings are supported by various studies emphasizing the adaptability and efficient feed utilization of Nile tilapia when exposed to diverse dietary ingredients. Further research could explore optimal inclusion rates and long-term effects on health and productivity in tilapia aquaculture. Overall, the dietary treatment with 33% curry leaves (T1) demonstrated the best performance across most growth parameters. These findings suggest that moderate inclusion of curry leaves can enhance growth performance and nutrient utilization in Nile tilapia, while excessive levels may lead to diminished outcomes. Overall, incorporating curry leaves into aquaculture diets presents a promising avenue for improving sustainable fish farming practices.

FUTURE SCOPE

Researchers should explore the optimal concentration of curry leaves for maximum growth and health benefits in Nile tilapia. Long-term studies are needed to assess overall health and reproductive performance. Investigating the biochemical mechanisms behind the benefits, as well as the economic feasibility and environmental impact, would provide practical insights. Additionally, examining the effects on disease resistance and consumer acceptance, and comparing curry leaves with other plant-based ingredients, could further enhance sustainable aquaculture practices.

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