

Assay of Growth and Nutritional Quality of Two edible fishes collected from Kullursandai Dam, Virudhunagar with relation to Physio- chemical factors

Murugalakshmi Kumari.R¹, Lenin Babu.V² and Dhanishta .N²

¹ Assistant Professor, Department of Botany, V.V. Vanniaperumal College for Women, (Autonomous), Virudhunagar-626001, Tamil Nadu, India. Email id: murugalakshmikumari@vvvcollege.org

² Department of Zoology, Virudhunagar Hindu Nadar Senthikumara Nadar College, (Autonomous), Virudhunagar-626001, Tamil Nadu, India. Email id: ghanishta.valarmathi01@gmail.com, leninbabuji01@gmail.com

[DOI:10.5281/FishWorld.15629549](https://doi.org/10.5281/FishWorld.15629549)

INTRODUCTION:

Artificial barriers, built across streams that flow year-round or seasonally, have numerous functions. Approximately 70% of the Earth's surface is comprised of water, which is essential for human existence. Human population growth, industrialization, the use of fertilizer in farming, and human-induced activities have significantly contaminated water sources (Ramachandra Mohan, 2018). Regular water quality testing is essential, with physical and chemical analysis being a top priority for evaluating water quality for drinking, irrigation, fish stocks, and industrial uses (Salve et al., 2006). This analysis aids in comprehending the intricate relationships and interactions between climatic and biological factors in water bodies. Length-weight relationships, denoted by the abbreviation LWRs, serve as essential tools for calculating the weight and biomass of fish, especially when direct field measurements are unfeasible. The connection between fish length and weight serves as a useful indicator for comprehending fish survival rates, growth patterns, maturity stages, reproductive capabilities, and overall health, as described by Le Cren (1951). Furthermore, LWRs enable the distinction of small taxonomic groups, given that variations occur within populations from diverse localities.

Fish is a vital source of nutrition, furnishing energy and critical fatty acids that impact its nutritional composition and quality. Studies highlight that eating fish lowers the risk of developing long-term health conditions, such as heart disease, atherosclerosis, and heart attack (Blanchet et al., 2000). Fish flesh biochemical composition, especially moisture content, is a reliable indicator of its protein, carbohydrate, lipid, and energy content. Lower moisture levels are associated with higher energy density (Aberoumad and Pourshafi et al., 2010). Fish is a high-

quality protein source, offering vital amino acids. In a number of underdeveloped nations, fish plays a key role in the diet, helping to alleviate protein and amino acid shortages (Eyo et al., 2001). Generally, low water content in fish muscle is linked with high fat and protein levels, suggesting stored energy reserves (Dempson et al., 2004). Freshwater fish, especially *Oreochromis mossambicus* and *Labeo rohita*, are economically significant due to their high nutritional value. As consumers become more concerned with the nutritional content of their food, biochemical studies on fish are necessary to assess the environmental implications of their consumption and understand their physiological requirements more effectively. Understanding the nutritional value of fish is crucial, and studying their tissues is vital for determining their disease susceptibility, as noted by Hultin (2005).

The investigation, undertaken at the Kullursandai Dam between December 2023 and February 2024, sought to examine the physical and chemical properties of dam water and their association with fish body length and weight. The study also assessed the nutritional values, encompassing the carbohydrate rate and protein content, of the gill, skin, and muscle tissue of *Oreochromis mossambicus* and *Labeo rohita*. This research will offer advice for fishermen on the most cost-effective fish species and provide information on the growth and nutritional benefits of these species during the post-monsoon period.

METHODOLOGY:

SITE SELECTION:

The research study was conducted at the Kullursandai Reservoir, situated close to the Kowsiga Mahanadi, which is a tributary to the Arjuna River (Latitude: 9.550612, Longitude: 77.972437). Located in Tamil Nadu's Virudhunagar District, the reservoir is



KULLURSANDHAI DAM

approximately 6 kilometres from Virudhunagar town. Built in 1979, this reservoir holds a total of 127 million cubic feet of water. It includes two irrigation sluices that supply water to 2,891 acres of land via the right and left main canals, situated on either side of the reservoir. The right main canal is approximately 3,500 meters in length, whereas the left main canal measures around 6,500 meters, with a discharge rate of 32.79 cusecs. The right and left main canals supply water to 1,431 acres and 1,450 acres of paddy fields, respectively. The Kullursandai Reservoir has a total catchment area of 278.64 square kilometers, with a water spread area of 6.14 square kilometers. The reservoir is impacted by both the northeast monsoon and the southwest monsoon.

Rainfall in the area fluctuates between a low of 110 mm and a high of 279 mm each year.

I. ANIMAL SELECTION:

Two species of fish, Tilapia (*Oreochromis mossambicus*) and Rohu (*Labeo rohita*), were sampled from the Kullursandai dam, as depicted in Plates 2 and 3. Taxonomic identification was conducted by referring to established sources like Wikipedia.



PLATE-2 -TILAPIA



PLATE -3- ROHU

CLASSIFICATION AND DESCRIPTION OF TILAPIA:

Phylum :	Chordata
Class:	Pisces
Order :	Perciformes
Family:	Cichlidae
Genus :	<i>Oreochromis</i>
Species :	<i>mossambicus</i>

This fish, known as *Oreochromis mossambicus*, has a medium body shape and is flattened from side to side. It also has two long fins on its back which contain between 10-13 rays and spines. Tilapia is well known by this name, with its scales being relatively large on the forehead and smaller elsewhere on the body. The colouration is a dull greenish-yellow hue with a faint banding pattern. The length of adult fish varies from 25 cm in females to 35 cm in males,

with an average male weight of 2.5 pounds and an average female weight of 2 pounds. *Oreochromis mossambicus* displays sexual dimorphism, showcasing distinct characteristics such as the width of the premaxilla, fin height, snout length, and nesting behavior.

CLASSIFICATION AND DESCRIPTION OF ROHU:

Phylum :	Chordata
Class:	Pisces
Order :	Cypriniformes
Family:	Cyprinidae
Genus :	<i>Labeo</i>
Species :	<i>rohita</i>

The Rohu, scientifically known as *Labeo rohita*, is a sizeable fish that belongs to the carp family and has an omnivorous diet. Widespread use of it is observed in aquaculture, and it can be located in rivers throughout South Asia. This fish, the Rohu, is characterised by its large size and silver colour, along with a distinctive arched head, typical of the cyprinid family. Typically, adults can attain a maximum weight of 45 kg and a maximum length of 2 meters, but they usually measure around 0.5 meters on average. The Rohu fish is found in rivers across India, Pakistan, Nepal, and Vietnam. During its early stages, its diet is primarily comprised of zooplankton, later shifting to phytoplankton as it matures, and then to submerged vegetation once it reaches juvenile or adult stages.

II. PHYSICO- CHEMICAL PARAMETERS OF WATER:

This research was conducted from December 2023 to February 2024, specifically during the post-monsoon period. Water samples were taken every two weeks to examine the physical and chemical properties of the water in the Kullursandai Reservoir. Digital instruments were submerged into collected water in a clean beaker to measure atmospheric temperature, dissolved oxygen, and electrical conductivity. For laboratory analysis, a sterile, 1000 ml polythene bottle was employed to collect water samples from various sampling locations. The water samples were taken to the laboratory at V.H.N.S.N. Situated in Virudhunagar, this autonomous college is about 5 kilometres from the Kullursandai reservoir.

PHYSICAL PARAMETERS:

In-situ surface water temperature readings were taken in the morning using a mercury thermometer. Measurements were collected from various sites around the reservoir to derive representative averages. Atmospheric temperature was recorded in degrees Celsius. In the morning, on-site atmospheric temperature was recorded with a mercury bulb thermometer. The ability of a substance or solution to conduct electricity was assessed through the use of a conductivity meter. The electrical conductivity of salts is due to the presence of ions, and this property is typically measured in terms of $\mu\text{S}/\text{cm}$.

CHEMICAL PARAMETERS:

The total dissolved solids in the water sample were determined by drying a filtered sample in a Petri dish and then weighing the remaining residue. The experiment was conducted on three separate occasions, with the average results being recorded each time. The modified Winkler method was used to estimate dissolved oxygen levels. Alkaline KI and MnSO_4 were added to water samples to stabilise dissolved oxygen. The formation of a brown precipitate suggests the presence of oxygen. The sample was then titrated against sodium thiosulphate, with starch serving as the indicator. Water quality assessment relies heavily on pH as a crucial parameter, which in turn affects numerous biological and chemical processes. The concentration of hydrogen ions is essential in evaluating water quality.

III. GROWTH PARAMETER:

Evaluating the relationship between length and weight is crucial in determining the growth of fish in aquaculture. This method is employed to assess the nutritional value of fish. The research was conducted on five separate occasions over a period of five days. Specimens with comparable body lengths and weights were selected, encompassing diverse species, and transported to the laboratory in an icebox. Measurements of length and weight were taken using a meter scale and a weighing machine.

IV. BIOCHEMICAL ANALYSIS OF FISH:

Estimations of biochemical components like protein (Lowry et al., 1951), as well as carbohydrates (Dubois et al., 1956), were made from the fish's gill, skin and muscle.

ESTIMATION OF CARBOHYDRATES:

Homogenization was carried out on 10 mg of fresh liver tissue and tilapia fish muscle tissue using 5 ml of a 30% potassium hydroxide solution. The homogenate was pipetted into a sterile test tube and immersed in a hot water bath for 15 minutes, while being occasionally agitated, before subsequently being cooled with a stream of running tap water. One milliliter of 95% ethanol was then cooled and allowed to stand for five minutes. The contents were then spun at 3000 rpm for 5 minutes. Supernatant was decanted and the precipitate was cooled in the ice

bath. Precipitate was dissolved in 2 ml of distilled water kept in the ice piece beaker. To this test tube 4ml of 0.2 % Anthrone reagent was added gradually by pipette and rapidly mixed to develop light green color. Then the tube was cooled to room temperature and the OD value was measured at 620 nm against the blank using a spectrophotometer. From the obtained OD value, the concentration of glucose was noted from the standard graph.

ESTIMATION OF PROTEIN:

After separating the liquid portion, the precipitate was then dissolved in 2 ml of a newly made alkaline CuSO₄ solution. The precipitate was collected after decanting the supernatant and dissolved in 2 ml of freshly prepared alkaline CuSO₄ solution. The solution was left to sit at room temperature for 10 minutes. Freshly prepared Folin-Ciocalteu reagent, 0.2 ml, was added and thoroughly mixed following this step. The solution was left to stand for 30 minutes in order for the blue color to develop, and its total volume was then increased to 5 ml using distilled water. The solution's absorbance was determined by comparing it to a blank at a wavelength of 650 nm via a spectrophotometer. A standard graph was constructed by plotting the absorbance values for various concentrations of Bovine serum Albumin, which were prepared using the same reagents previously mentioned. The protein quality in tissue samples was quantified using a standard graph.

RESULT AND DISCUSSION:

This study examined the growth patterns of Tilapia and Rohu, examining several key factors and comparing physical and chemical characteristics with the fish's length and weight. The findings revealed a steady rise in surface temperature (24.75°C to 26.5°C), atmospheric temperature (25.7°C to 27.45°C), electrical conductivity (322.6 to 347.5 µS/cm), total dissolved solids (85.55 to 91.15 mg/l), pH (6.25 to 6.45), and dissolved oxygen levels (4.46 to 7.45) between December and February. The growth was accompanied by increases in length and weight for both Tilapia and Rohu. The analysis revealed that small fish had greater carbohydrate levels in the gill, skin, and muscle areas than medium and large fish in both Tilapia and Rohu. Furthermore, small fish exhibited higher protein content in the gill, skin, and muscle areas than their medium and large counterparts in both species. The temperature of surface water is closely linked to the temperature of the surrounding atmosphere. According to the current research, atmospheric temperature rose steadily from 24.7°C to 26.5°C. Tilekar (2013) noted a rise in surface water temperature from 21.6°C to 27°C over the period from December to February. Possible factors in the heightened atmospheric temperature include solar radiation and clear skies, as suggested by Mohemad Toufeek (2009). Physical parameters such as atmospheric temperature were recorded during the post-monsoon period, which spans from December to February, in the Kullursandai reservoir. The findings revealed a rise in atmospheric temperature

from 25.7°C to 27.4°C. Research conducted at the Thodga reservoir in Maharashtra revealed a comparable pattern (Patel, 2008; Tilekar, 2013). The rise in atmospheric temperatures signals the shift from meteorological events to changing seasonal patterns (Aruna Kumar Namdeo, 2013). The electrical conductivity and mineral accumulation levels change with the season and type of water body (Baijio et al., 1997). This research found that electrical conductivity rose from 322.6 µS/cm to 347.5 µS/cm between December and February. The measured value is in line with the electrical conductivity range of 312-380 µS/cm reported in the Limboti Dam of Maharashtra (Chaudhari, 2014). The rise in electrical conductivity is thought to be due to the concentration of minerals and salts within the water (Sayyed Hussain, 2012). The present investigation found that total dissolved solids levels varied over a range of 85.55 to 91.15 milligrams per liter. The highest level of TDS was observed in February at 91.15 mg/L, whereas the lowest level was noted in December at 85.55 mg/L. According to Alaka's study in 2014, the water samples from Borgaon contained a broader range of TDS levels, specifically between 347.16 and 738.0 mg/L. The rise in total dissolved solids is attributed to an increase in salts that include bicarbonate, chloride, phosphate, sulfate, nitrate, iron, and manganese, in addition to carbonate (Gonzalez et al., 2004). In the post-monsoon season, the water in the reservoir exhibited minor pH variations, spanning a range of 6.25 to 6.45. Corresponding values were found by Sermamoorthy (2017). A slight pH increase is likely due to effluent from household water, small-scale industries, and the incorporation of rainwater during the monsoon season as observed by Kamble in 2008. Dissolved oxygen levels are a crucial factor influencing the survival and dispersal of plant and animal life within an ecosystem. Activity levels in water are influenced by temperature. A consistent rise in dissolved oxygen levels was noted from December to February at the Kullursandai reservoir, spanning a concentration range of 4.46 mg/L to 7.45 mg/L. The Harsul Dam in Maharashtra exhibited a comparable range of DO, as noted by Samarat (2012). A mild increase in DO during the rainy season may be due to an influx of rainwater from nearby areas and the time following the monsoon season (Bhatt et al., 1999). Evaluating the length-weight relationship proved to be a more effective method for examining the growth parameters of fish. Understanding this relationship is crucial in creating aquaculture techniques for large-scale commercial production of valuable fish species, such as those mentioned by Rajkumar et al. (2006). The present investigation focused on the growth parameters of Tilapia and Rohu. The length of the Tilapia fish (*Oreochromis mossambicus*) was raised from 19.8 cm to 30.8 cm, and the length of Rohu (*Labeo rohita*) was extended from 18.7 to 30 cm and the weight was raised from 183 to 539.3 gm. Comparable findings were noted in the Idukki reservoir by Gobinath Nair in 1988. Umaru reported in 2015 that alterations in physical and chemical parameters may impact growth parameters. In the present investigation,

the carbohydrate content of the tilapia fish (*Oreochromis mossambicus*) was high in small fish (Gills- 86.mg/g ;Skin-87.3 mg/g and in muscle -93.66 mg/g) and lesser in large fish (Gills- 61.3 mg/g; Skin- 60mg/g and in muscle -62 mg/g) and in rohu fish (*Labeo rohita*). The carbohydrate content was found in higher amounts in larger fish (Gills: 60mg/g; Skin: 59.6 mg/g; and in muscle: 55.3 mg/g) compared to larger fish (Gills: 47.3mg/g; Skin: 52.3mg/g; and in muscle: 48.3mg/g). Smaller fish are still developing and may allocate more resources towards growth rather than detoxification or elimination of substances. Higher levels of the substance could accumulate in their tissues as a result. (Phillips, 2017). The current study found that the protein content in tilapia fish (*Oreochromis mossambicus*) was higher in smaller individuals, specifically 78.66mg/g in the gills, 67mg/g in the skin, and 87.3 mg/g in the muscle, whereas in larger fish, it was lower at 72.3mg/g in the gills, 65.3mg/g in the skin, and 75.3 mg/g in the muscle. Similarly, in Rohu (*Labeo rohita*), the protein content was higher in smaller fish, at 65.6 mg/g in the gills, 64.3 mg/g in the skin, and 63.3 mg/g in the muscle, whereas in larger fish, it was lower at 43.3mg/g in the gills, 55.6 mg/g in the skin, and 60.3 mg/g in the muscle. Varying fish species exhibit distinct protein requirements and metabolic rates. The differences in protein content observed between tilapia and Rohu fish are likely due to factors unique to each species. Conditions like water temperature and purity can impact the accessibility of nutrients and impact fish metabolic rates and development. Differences in environmental conditions between the habitats of small and large fish may be responsible for variations in protein content (Weatherly et al., 1988). Variations in environmental conditions between habitats inhabited by small and large fish could contribute to differences in protein content (Weatherly et al.,1988).

FUTURE DIRECTION:

Future research on the Kullursandai reservoir's ecosystem and its fish populations' growth patterns should concentrate on extending the study duration to encompass a whole year, thereby enabling a thorough examination of seasonal fluctuations. Comprehensive studies on nutrient accessibility, histological transformations in fish tissues, and population fluctuations are crucial. Furthermore, evaluating the effects of human-induced activities, performing genetic examinations to determine potential markers linked to growth, and testing microbial loads will yield a more comprehensive understanding of the factors affecting fish growth. Future studies will aid in creating effective conservation and management plans, guaranteeing the long-term use of this highly valuable aquatic resource.

CONCLUSION:

The recent study showed a clear link between rising physicochemical factors, including temperature, conductivity, TDS, pH, and dissolved oxygen levels, and the growth of Tilapia and Rohu fish in the Kullursandai reservoir following the post-monsoon season. Significantly, the

research found that smaller fish of both species had higher levels of carbohydrates and proteins in their tissues compared to the larger fish, indicating that more resources were devoted to growth during their early life stages. These results offer significant insights into the ecological dynamics of the reservoir, and underscore the impact of environmental factors on fish growth and physiology.

SUPPLEMENTARY MATERIALS:

A comprehensive dataset, featuring a table of all values and various graphic representations including bar charts, has been compiled in a document format and made available as supplementary material in a Google Drive folder located at <https://drive.google.com/drive/folders/1V7a8omOJ4qY8rIXzmtJoKOaasEeSz9Pt>

REFERENCES:

- Aberoumd, A. and Pourshafi.K.2010. Chemical and proximate composition properties of different fish species obtained from iron. World journal of fish and marine science, 2 (3): 237- 239.
- Arunakumar Namdeo. 2013. Hydro biology of a tropical reservoir with special reference to seasonal flux in certain physico- chemical parameter, International journal of advanced life science, Vol(6), Issue (4).
- Baijio, E., Moreau, J. and Bouada Sana . 1997. Hydrobiological aspects of fisheries in Sabel region. Technical centre for agricultural and rural co-operation. ACP-EU.220.
- Bhatt, L.R.P.Cacoul., H.D.L.Akhak and Jha. P.K. 1999. Physico- chemical characteristics and phytoplanktons of Taudaha Lake, Kathmandu. Poll. Res.18(4) pp: 48-52.
- Blanchet, C.E, Dewaily, P. Ayotte, S. Bruneau, O. Receveur and B.J. Holub, 2000. Contribution of selected traditional and market foods to the diet of Nunavik Inuit women. Can. J. Diet Pract. Res., 61: 50-59.
- Chaudhari, U.P.2014. Physico-chemical parameters assessment of dam water in different sites of Warud region, Vol 7, No-2, 156-160.
- Dempson, J. B., Schwarz, C.T. Shears, M. and Furey,G. 2004. Comparative proximate body composition of. Atlantic salmon with emphasis on parr from fluvial and lacustrine habitats.Journal of Fish Biology. 1; 64(5): 1257-71.
- Gobinath Nair. P. 1983. Length- Weight relationship of tilapia of *mossambicus* of Idukki reservoir.
- Gonzalez, Ortaz, E.J. Panaherrera, M.C and Infante, A. 2004. Physical and chemical features of a hypertrophic reservoir permanently Stratified, Hydrobiologia, 522:301-310.
- Hultin, H.O.2005. Characteristics of muscle tissue. In:Fennema, O.R. (Ed). Food Chemistry, 2nd ed. Marcel Dekker, New York, p.725.
- Kiron ,V. 2012. Fish Immune system and its nutritional modulation for preventive health care Animal Feed science and technology, 173(1-2),111-113
- Le Cren, E.D. 1951. The length-weight relationships and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). Journal of Animal Ecology.; 20:201-219
- Mohamed Toufeek, A.F. 2009. Physico chemical characteristics of water, global journal of environmental research (3) : 141-148.
- Patil, P.V. 2008. Study of selected Physico chemical factor of reservoir Thoda, Ahmedpur Dist lakes, Maharashtra.
- Phillips, J.B. and Yousif, O.M .2017. Heavy metals accumulation in tissues of *Cyprinus carpio* and *Oreochromis niloticus* from the Zarqa River , Jordan, Aquatic Environments

- Health & Management, 20(2),165-171.
- Rajkumar, M., Antony P.J., and Trilles, J.P .2006. Length-weight Relationship of Asian Seabass (*Lates calcarifer* Bloch, 1970) from Pichavaram Mangrove Waters, South East Coast of India. *Asian Fisheries Science* 19: 177-183.
- Ramachandra Mohan, M. 2018. Is Neem Oil Harmful to Fish G giuris Volume-7 | Issue-1 |January-2018 | ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 93.98m page 597-598"Impact Factor Of Ijsr : 4.176.
- Samrat.A.D.2012. Study of the Physico-chemical parameters of Harsul Dam , Aurangahad (M.S), Proceedings of International conference, SWRDM.
- Sayyed Hussain .2013. Physio- chemical analysis of limbo ti dam water, Nanded, Maharashtra. *Journal Advanced scientific research*.
- Sermamoorthy .S, 2017. Growth and biochemical study of the fish *Oreochromis mossambicus* with relation to physico-chemical parameters during the post -monsoon season in Kullursandai Reservoir of Virudhunagar District, Tamilnadu. Vol:3.
- Tilekar,B.B. 2013. Hydro biological studies of Manikdaundi dam from Pathardi : tashil (M.S), India. *Applied Research and development institute journal*, 7(9):61-67.
- Umaru, J.A. 2015. Length- Weight relationship and condition factor of some selected fish species in doma dam nasarwa state Nigeria, octo journal: vol.3 (2): 83-85.
- Weatherley, A.H. and Gill, H.S. and Lobo.,A.F . 1988 Protein turnover in *Tilapia mossambicus* . Effects of body Size and Temperature, *Journal of Fish Biology*, 33(1),115-130.