MARKHOR
THE JOURNAL OF ZOOLOGY
https://www.markhorjournal.com/index.php/mjz
ISSN (P): 2790-4377, (E): 2790-4385
Volume 5, Issue 4 (Oct-Dec 2024)

Original Article

OPEN ACCESS

Proximate Composition of *Rita rita* from Southern Punjab, Pakistan

Saif Ur Rehman[1*], Naheed Bano[1], Muhammad Asif Raza[1], Hafiz Muhammad Ishaq[1]

[1]Department of Zoology, Wildlife and Fisheries, Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan

ARTICLE INFO

Keywords:
Rita rita, Proximate Body Composition, Ash Content, Aquaculture

How to cite:
Rehman, S. ur, Bano, N., Asif Raza, M., & Ishaq, H. M. (2024). Proximate Composition of *Rita rita* from Southern Punjab, Pakistan: Proximate Composition of *Rita rita*. MARKHOR (The Journal of Zoology), 5(04), 23-28. https://doi.org/10.54393/mjz.v5i04.126

***Corresponding Author:**
Saif Ur Rehman
Department of Zoology, Wildlife and Fisheries, Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan
msaif4343@gmail.com

Received Date: 18th November, 2024
Acceptance Date: 27th December, 2024
Published Date: 31st December, 2024

ABSTRACT

Fish and fish products are considered essential in the human diet due to their high nutritional content, particularly protein and omega-3 fatty acids, which are believed to help maintain good health and prevent cardiovascular, inflammatory, and neurological conditions. **Objective:** To evaluate the proximate *Rita rita* body composition of the freshwater catfish *Rita rita* from Pakistan. **Methods:** Fifty samples of were collected from River Chenab Head Muhammad wala, Multan, Punjab and their proximate body composition was evaluated. Descriptive statistics were used to summarize the data, while independent t-tests and correlation analyses were performed to evaluate relationships among morphometric parameters and body constituents. **Results:** Results showed that the fish contained 77.62 ± 3.47% water, 0.73 ± 0.19% ash (wet weight), 0.87 ± 0.19% fat (wet weight), and 20.78 ± 3.32% protein (wet weight). Correlation analysis revealed that water content was highly significantly correlated with protein (r=0.996), organic content (r=0.999), and ash (r=0.339), while body weight showed significant correlations with most body constituents, including fat (r=0.808) and protein (r=0.628). **Conclusion:** It is concluded that fish collected from the studied sampling site comprises good nutritional quality, especially in respect to fats and protein content, and hence highly recommended for consumption. Findings of the research work will be important for consumers to select proteinaceous fish and useful for nutritionists and ichthyologists working on the fish quality meat.

INTRODUCTION

In aquaculture, growth is a key component characterized by changes in size and tissue composition. Fish and fish products are considered essential in the human diet due to their high nutritional content, particularly protein and omega-3 fatty acids, which are believed to help maintain good health and prevent cardiovascular diseases [1, 2]. Due to their higher content of polyunsaturated fats compared to other animal fats, fish are beneficial in medicine, particularly for lowering blood cholesterol [3]. The proximate composition of each fish species varies and is influenced by both exogenous and endogenous factors, including feeding conditions, water quality, fish sex and age, catch period, water temperature, feeding habits, seasonal variations, species-specific traits, condition factor, size, and activity levels [4-6]. The study of these proximate components provides a clear understanding of the energy value of fishes [7]. Moisture percentage can indicate content, with lower moisture indicating higher level of these content. For instance, different species of fish were reported to have low fat, protein, and calorie protein content in the incidence of high water content of muscle [8]. The study of muscle components of fish such as fat, protein, and calories, gives us a clear understanding in assessing the energy value of the fishes. Fish typically contains 66%–81% water, 16%–21% protein, 1.2%–1.5% mineral, 0.2%–25% fat, and 0%–0.5% carbohydrate. Carbohydrates and non-protein compounds are often in negligible percentages, typically <0.5% [7, 8]. The freshwater catfish, which belongs to the family Bagridae and the genus Rita, is commonly found in South Asia and is

DOI: https://doi.org/10.54393/mjz.v5i04.126

highly valued for its flavorful meat [9].
This study aimed to evaluate the proximate body composition of the freshwater catfish *Rita rita* from Pakistan.

METHODS

For this study, a total of fifty samples were taken and tested. Fifty samples of *Rita rita* were collected from River Chenab Head Muhammad wala, Multan, Punjab, Pakistan. Each specimen was weighed to the nearest 0.01 gram after debris and water removal. Body length was measured to the nearest 0.01 centimeter. Sample were dried in an oven (70-80°C) until the constant mass was obtained [10]. The total moisture was calculated as
Water content = Initial weight -Weight after drying
The dry substance of each fish specimen was ground and homogenized, followed by storage in airtight plastic jars. Ash content was measured by burning the dry samples in a muffle furnace (550°C for 24 hours). After cooling, the samples were weighed to determine ash content as:
Ash content=Initial weight -Weight loss after incineration
A 2:1 v/v mixture of chloroform and methanol was used to extract fat content [11]. The weighted powder of each fish sample was placed in a test tube, combined with the solvent solution, stirred, and covered with aluminum foil. It was kept overnight and then centrifuged. The clear supernatant was transferred into pre-weighed glass bottles and evaporated in an oven to leave behind lipid fractions. The total fat content was determined by using formulae [10]:
Fat = initial weight of sample – final weight of sample x 100
The protein content was calculated by [12]:
Protein content = 100 – (All Other Body Contents)
The current study utilized the Statistical Package for the Social Sciences software (SPSS) version 26 for all statistical tests. Descriptive analysis was used to find the mean, standard deviation and range of continuous variables. The independent sample t-test analysis was used to explore the difference in the mean body composition parameters between the groups. To assess the nature and the degree of association between two quantitative variables, correlation analysis was conducted with results presented in form of Pearson's correlation coefficients (r). Regression analyses were run for the study looking at the effects of body length and weight on composition parameters Further, standard errors and the R^2 values for each of the developed models are presented. The level of significance used for study was 0.05.

RESULTS

Fifty samples of wild *Rita rita* were selected for estimation of their body composition study. The analysis revealed an average of water composition (%) to be 77.62 ± 3.47 (range: 70.86 to 83.47). Protein content being significantly high was reported to be 20.78±3.32 (range: 15.34 to 27.40) in wet weight and 92.79± 1.33 (range: 90.07 to 95.50) in dry weight. However, fat and ash levels remained comparatively low across both wet and dry weights as shown in table 1.

Table 1: Mean and Range Values of Various Body Constituents of *Rita rita*

Parameter	Mean ± S.D	Range
Water%	77.62 ± 3.47	70.86-83.47
Ash Wet Wt. %	0.73 ± 0.19	0.33-1.15
Ash Dry Wt. %	3.29 ± 1.87	1.87-5.53
Fat Wet Wt. %	0.87 ± 0.54	0.54-1.45
Fat Dry Wt. %	3.92 ± 0.79	2.55-5.73
Protein Wet Wt. %	20.78 ± 3.32	15.34-27.40
Protein Dry Wt. %	92.79 ± 1.33	90.07-95.50
OC Wet Wt. (%)	21.65 ± 3.41	16.08-28.38
OC Dry Wt (%)	96.71 ± 0.81	94.47-98.13

Wet Wt=ash in wet weight; Dry Wt=dry weight; OC Content=Organic content

Statistical analyses of total length and other body constituents in both wet wt. and dry wt. of *Rita rita* respectively (Table 2). Total length showed highly significant with % water with r=0.669, fat wet wt with r value 0.784, percent protein wet wt. r=0.626 and percent organic content in wet wt. r=0.654; significant correlation was found with percent ash wet wt, correlation r=0.485; least significant with percent fat dry wt. as r=0.385 and non significant correlation with percent ash, protein and organic content dry weight.

Table 2: Descriptive Statistical Analysis of Total Length (TL, cm) With Various Body Constituents for *Rita rita*

Equation	a	b	S.E (b)	r	r^2
% Water = a+b TL	27.857	2.511	0.403	0.669***	0.447
% Ash Wet Wt. = a+b TL	2.682	-0.098	0.026	-0.485**	0.236
% Ash Dry Wt. = a+b TL	5.464	-0.109	0.125	$-0.125^{n.s}$	0.016
% Fat Wet Wt. = a+b TL	4.090	-0.162	0.019	-0.784***	0.615
% Fat Dry Wt. = a+b TL	9.984	-0.306	0.115	-0.358*	0.128
% Pro. Wet Wt. = a+b TL	65.370	-2.250	0.405	-0.626***	0.392
% Pro. Dry Wt. = a+b TL	84.552	0.416	0.200	$0.288^{n.s}$	0.083
% OC Wet Wt. = a+b TL	69.460	-2.412	0.403	-0.654***	0.427
% OC Dry Wt. = a+b TL	94.536	0.109	0.125	$0.125^{n.s}$	0.016

Pro= protein; r = Correlation Coefficient; a = Intercept; b = Slope; S.E= Standard Error

Log total length showed highly significant with % water, ash wet wt., fat wet wt., protein wet wt. and organic content wet wt. with r values 0.666, 0.507, 0.782, 0.622 and 0.651 respectively. Significant with fat dry wt. with r=0.369 and all others showed non-significant correlation as shown in table 3.

DOI: https://doi.org/10.54393/mjz.v5i04.126

Table 3: Descriptive Statistical Analysis of Log Total Length (TL, cm) With Various Body Constituents for *Rita rita*

Equation	a	b	S.E (b)	r	r^2	t-value
Log % Water = a+b Log TL	1.062	0.638	0.103	0.666***	0.443	-22.864
Log % Ash Wet Wt. = a+b Log TL	3.612	-2.902	0.712	-0.507***	0.257	-8.292
Log % Ash Dry Wt. = a+b Log TL	1.424	-0.710	0.771	-0.132$^{n.s}$	0.017	-4.814
Log % Fat Wet Wt. = a+b Log TL	4.774	-3.736	0.429	-0.782***	0.612	-15.693
Log % Fat Dry Wt. = a+b Log TL	2.586	-1.543	0.562	-0.369**	0.136	-8.088
Log % Pro. Wet Wt. = a+b Log TL	4.042	-2.106	0.382	-0.622***	0.387	-13.357
Log % Pro. Wet Wt. = a+b Log TL	1.855	0.087	0.042	0.283$^{n.s}$	0.080	-68.619
Log % OC Wet Wt. = a+b Log TL	4.145	-2.171	0.365	-0.651***	0.424	-14.169
Log % OC Dry Wt. = a+b Log TL	1.958	0.021	0.026	0.120$^{n.s}$	0.014	-116.661

Statistical analyses in table 4. showed highly significant correlation with % water with r=0.679, ash wet wt. with r value 0.611, percent fat wet wt. with r=0.808, percent protein wet and dry wt. r=0.628 and percent organic content in wet wt. r=0.657; significant correlation was found with percent fat dry wt, correlation r=0.375; non-significant correlation with percent ash, and organic content dry weight.

Table 4: Descriptive Statistical Analysis of wet body wt. (g) with various body constituents for *Rita rita*

Equation	a	b	S.E (b)	r	r^2
% Water = a+b TL	62.630	0.183	0.029	0.679***	0.460
% Ash Wet Wt. = a+b TL	1.460	-0.009	0.002	-0.611***	0.373
% Ash Dry Wt. = a+b TL	4.584	-0.016	0.009	-0.251$^{n.s}$	0.063
% Fat Wet Wt. = a+b TL	1.855	-0.012	0.001	-0.808***	0.652
% Fat Dry Wt. = a+b TL	5.803	-0.023	0.008	-0.375**	0.141
% Pro. Wet Wt. = a+b TL	34.054	-0.162	0.029	-0.628***	0.394
% Pro. Dry Wt. = a+b TL	34.054	-0.162	0.029	-0.628***	0.394
% OC Wet Wt. = a+b TL	35.909	-0.174	0.029	-0.657***	0.431
% OC Dry Wt. = a+b TL	95.416	0.016	0.009	0.251$^{n.s}$	0.063

ns= not significant

Statistical analyses of log wet wt. and other body constituents in both wet wt. and dry wt. of *Rita rita* respectively, as shown in table 5. Log wet wt. showed highly significant correlation with % water with r=0.674, ash wet wt. with r value 0.635, percent fat wet wt. with r=0.817, percent protein wet wt. r=0.635 and percent organic content in wet wt. r=0.665; significant correlation was found with percent fat dry wt, and protein dry weight correlation r=0.368; non-significant correlation with percent ash, and organic content dry weight.

Table 5: Descriptive Regression Analysis of Log Wet Body wt. (W, g) with Different Body Constituents for *Rita rita*

Equation	a	b	S.E (b)	r	r^2	t-value
Log % Water = a+b Log TL	1.521	0.193	0.031	0.674***	0.455	-91.887
Log % Ash Wet Wt. = a+b Log TL	1.923	-1.087	0.191	-0.635***	0.404	-21.438
Log % Ash Dry Wt. = a+b Log TL	1.289	-0.411	0.225	-0.255$^{n.s}$	0.065	-15.185
Log % Fat Wet Wt. = a+b Log TL	2.156	-1.166	0.119	-0.817***	0.668	-35.096
Log % Fat Dry Wt. = a+b Log TL	1.522	-0.491	0.166	-0.392**	0.154	-21.011
Log % Pro. Wet Wt. = a+b Log TL	2.537	-0.642	0.113	-0.635***	0.403	-32.287
Log % Pro. Wet Wt. = a+b Log TL	1.903	0.034	0.012	0.368**	0.135	-241.059
Log % OC Wet Wt. = a+b Log TL	2.596	-0.663	0.107	-0.665***	0.443	-34.130
Log % OC Dry Wt. = a+b Log TL	1.961	0.013	0.007	0.237$^{n.s}$	0.056	-399.981

Log WW= Logarithm of Wet Weight

The condition factor showed significant correlation with percent ash dry wt, correlation r=0.388 and non-significant correlation with all remaining body constituents (Table 6).

Table 6: Descriptive Statistical Analysis of Condition Factor with Various Body Constituents for *Rita rita*

Equation	a	b	S.E (b)	r	r^2
% Water = a+b TL	68.908	8.319	6.616	0.179$^{n.s}$	0.032
% Ash Wet Wt. = a+b TL	1.755	-0.978	0.335	-0.388**	0.151
% Ash Dry Wt. = a+b TL	6.561	-3.120	1.500	-0.288$^{n.s}$	0.083
% Fat Wet Wt. = a+b TL	1.558	-0.657	0.359	-0.255$^{n.s}$	0.065
% Fat Dry Wt. = a+b TL	5.312	-1.332	1.519	-0.126$^{n.s}$	0.016
% Pro. Wet Wt. = a+b TL	27.778	-6.685	6.365	-0.150$^{n.s}$	0.022
% Pro. Dry Wt. = a+b TL	88.126	4.452	2.505	0.249$^{n.s}$	0.062
% OC Wet Wt. = a+b TL	29.337	-7.342	6.524	-0.160$^{n.s}$	0.026
% OC Dry Wt. = a+b TL	93.439	3.120	1.500	0.288$^{n.s}$	0.083

Where K is the condition factor

Statistical analyses of log condition factor and other body constituents in both wet wt. and dry wt. of *Rita rita* respectively, as shown in Table 7. Condition factor showed significant correlation with percent ash wet wt, correlation r=0.398, least significant with percent ash dry weight with r=0.303 and non-significant correlation with all remaining body constituents.

Table 7: Descriptive Statistical Analysis of Log Condition Factor with Various Body Constituents for *Rita rita*

Equation	a	b	S.E (b)	r	r^2	t-value
Log % Water = a+b Log TL	1.887	0.108	0.090	0.171$^{n.s}$	0.029	-32.176
Log % Ash Wet Wt. = a+b Log TL	-0.122	-1.501	0.499	-0.398**	0.158	-9.015
Log % Ash Dry Wt. = a+b Log TL	0.525	-1.074	0.488	-0.303*	0.092	-8.343
Log % Fat Wet Wt. = a+b Log TL	-0.055	-0.803	0.439	-0.255$^{n.s}$	0.065	-8.658

DOI: https://doi.org/10.54393/mjz.v5i04.126

Log % Fat Dry Wt. = a+b Log TL	0.592	-0.376	0.395	-0.136$^{n.s}$	0.019	-8.555
Log % Pro. Wet Wt. = a+b Log TL	1.319	-0.377	0.317	-0.169$^{n.s}$	0.029	-10.644
Log % Pro. Wet Wt. = a+b Log TL	1.966	0.051	0.028	0.250$^{n.s}$	0.063	-104.409
Log % OC Wet Wt. = a+b Log TL	1.338	-0.394	0.312	-0.179$^{n.s}$	0.032	-10.881
Log % OC Dry Wt. = a+b Log TL	1.985	0.033	0.016	0.284$^{n.s}$	0.081	-182.520

Statistical analyses of percent water and log percent water with other body constituents in both wet wt. and dry wt. of *Rita rita* respectively, as shown in Table 8 and 9. Percent water showed highly significant with total length (TL) with r=0.669, with wet wt. r=0.679, fat wet wt with r value 0.502, percent protein wet wt. r=0.996 and percent organic content in wet wt. r=0.999; least significant correlation was found with percent ash wet wt, correlation r=0.339; and non significant correlation with percent ash, fat, protein and organic content in dry wt. of analysis.

Table 8: Descriptive Regression Analysis of Percent Water with Different Body Constituents for *Rita rita*

Equation	a	b	S.E (b)	r	r^2
TL= a+b % water	5.993	0.178	0.029	0.669***	0.447
W = a+b % Water	-113.626	2.521	0.394	0.679***	0.460
% Ash Wet Wt. = a+b % Water	2.154	-0.018	0.007	-0.339*	0.115
% Ash Dry Wt. = a+b % Water	-0.695	0.051	0.033	0.221n.s	0.049
% Fat Wet Wt. = a+b % Water	3.019	-0.028	0.007	-0.502***	0.252
% Fat Dry Wt. = a+b % Water	0.018	0.050	0.032	0.221n.s	0.049
% Pro. Wet Wt. = a+b % Water	94.827	-0.954	0.012	-0.996***	0.993
% Pro. Dry Wt. = a+b % Water	100.677	-0.102	0.054	-0.264n.s	0.070
% OC Wet Wt. = a+b % Water	97.846	-0.982	0.007	-0.999***	0.997
% OC Dry Wt. = a+b % Water	100.695	-0.051	0.033	-0.221n.s	0.049

Table 9: Descriptive Regression Analysis of log % Water with Different Body Constituents for *Rita rita*

Equation	a	b	S.E (b)	r	r^2	t-value
Log TL= a+b Log % Water	-0.015	0.694	0.112	0.666***	0.443	-20.525
Log W = a+b Log % Water	-2.537	2.353	0.372	0.674***	0.455	-1.740
Log % Ash Wet Wt. = a+b Log % Water	3.793	-2.087	0.807	-0.350**	0.122	-6.305
Log % Ash Dry Wt. = a+b Log % Water	-2.012	1.332	0.788	0.237$^{n.s}$	0.056	-2.118
Log % Fat Wet Wt. = a+b Log % Water	4.747	-2.549	0.617	-0.512***	0.262	-8.988
Log % Fat Dry Wt. = a+b Log % Water	-1.058	0.869	0.618	0.199$^{n.s}$	0.040	-3.450
Log % Pro. Wet Wt. = a+b Log % Water	7.935	-3.505	0.059	-0.993***	0.987	-110.892
Log % Pro. Wet Wt. = a+b Log % Water	2.130	-0.086	0.044	-0.269$^{n.s}$	0.072	-69.403
Log % OC Wet Wt. = a+b Log % Water	7.870	-3.461	0.046	-0.996***	0.992	-140.967
Log % OC Dry Wt. = a+b Log % Water	2.065	-0.042	0.026	-0.228$^{n.s}$	0.052	-116.483

DISCUSSION

Present study describes comprehensive information and scientific evidence of proximate composition of freshwater edible fish of *Rita rita*. Water content in the present study was found in normal range (60-80%) as reported by various scientists. Percentage of this content was found very close to that of farmed *Ctenopharyngodonidella* (80.76 ± 4.40) reported by Khalid and Naeem [13] in Hybrid, (79.22- 80.83%) reported by Iqbal *et al.* [14]; and in the head flesh of *Rita rita* (84.5%) as studied by Khan *et al.*, [9]. However, Gul *et al.* have found lower percentage of this content in some species (*Garragotyla*, *Garragotyla*) of family Cyprinidae [15]. Ash content range in fish is reported as 0.89-8.00% in different fish species by various fisheries scientists. This constituents in *Rita rita* in the present work being 2.77% shows to be in normal limit. Percent value of ash was found comparable with that of studied by Naeem *et al.* in *Cirrhinus mrigala* (2.87±0.54%) [14], by Kousar *et al.* in Genetically Improved Farmed Tilapia (GIFT) (2.75- 3.30%) [16]. Another study also found low percentage of ash (0.89%) in the flesh of *Rita rita*. Our findings are however opposed by the results that reported too high percentage (8.00%) of this content in another Cyprinid [15]. Fat contents of *Rita rita* were found to be only 2.98% for the present study and within the range (2.5-6.00%) as studied by various ichthyologists. This finding is in agreement with the results that highlight the fat content of Puntius chola and *Cirrhinus mrigala*, respectively [9]. However, on the contrary, a previous study done on seven fishes reported the maximum lipid and fat content in *Rita rita* [17]. Comparison of protein content among different fish species shows that it ranges from 10-20% in wet wt. of fish. Hence, this constituent was found within the range as documented by various authors. Bano *et al.*, have also documented percentage of protein range in *Labeocalbasu* being 13.87- 15.66% in different treatments feeding different levels of dietary protein [18]. This study also depicted the effect of fish size on the body composition of *Rita rita*. Previously, Mitra *et al.*, also determines the impact of size on the biochemical composition of *Rita rita* fish, showing the medium sized fishes with highest protein and minimum fats [19]. These finding also verifies the results of different studies also documented a definite effect of size of *Ctenopharyngodon idella*, *Catla catla*, *Labeoo calbasu*, GIFT (Genetically Improved Farmed Tilapia), *Clarias batrachus* and Hybrid fish (*Catlacatla*♂ and *Labeorohita*♀) on proximate composition [13, 16, 20]. Though, in spite of the differences, the range of protein in different species of fish study shows that these fishes are good sources of protein to consumers. Present

DOI: https://doi.org/10.54393/mjz.v5i04.126

study describes comprehensive information and scientific evidence of proximate composition of freshwater edible fish of *Rita rita*. The proximate composition of *Rita rita* was evaluated to determine its importance and quality for human consumption. Results of the present study indicated that *Rita rita* constitutes a low fatty acid and ash content while a high source of protein and thus can be described as an ideal dietetic fish food for human consumption.

CONCLUSIONS

This study highlights the proximate composition of *Rita rita,* indicating its quality in terms of its nutritional value, high protein content and low amounts of fat. The correlations between morphometric parameters and body constituents imply that size and condition enhance the nutritional value of the fish. Thus, these results support the inclusion of *Rita Rita* in the diet and may interest people who consciously care about their diet. This research contributes new information to ichthyologists and nutritionists to encourage the consumption of *Rita rita* in human diets. Enhancing the nutritional parameters of this dish is also an aspect that further research should explore.

Authors Contribution

Conceptualization: NB, MAR
Methodology: SUR
Formal analysis: SUR
Writing, review and editing: SUR, HMI

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

All the authors declare no conflict of interest.

Source of Funding

The author received no financial support for the research, authorship and/or publication of this article.

REFERENCES

[1] Jan K, Ahmed I, Dar NA. Hematological and Serum Biochemical Reference Values of Snow Trout, Schizothorax Labiatus Habiting in River Sindh of Indian Himalayan Region. Journal of Fish Biology. 2021 Dec; 98(5): 1289-1302. doi: 10.1111/jfb.14661.

[2] Mohanty BP, Mahanty A, Ganguly S, Mitra T, Karunakaran D, Anandan R. Nutritional Composition of Food Fishes and Their Importance in Providing Food and Nutritional Security. Food Chemistry. 2019 Sep; 293: 561-70. doi: 10.1016/j.foodchem.2017.11.039.

[3] Kandyliari A, Mallouchos A, Papandroulakis N, Golla JP, Lam TT, Sakellari A, *et al.* Nutrient Composition and Fatty Acid and Protein Profiles of Selected Fish By-Products. Foods. 2020 Feb; 9(2): 190. doi: 10.3390/foods9020190.

[4] Gull A, Zafar FHS, Panhwar S, Bat L, Zahid M. Seasonal Determination of Proximate Composition and Essential Elements in Commercial Fishes from Pakistan and Human Health Risk Assessment. Foods and Raw Materials. 2024 Nov; doi: 10.21603/2308-4057-2024-2-614.

[5] Tsentalovich Y, Zelentsova E, Savina ED, Yanshole V, Sagdeev R. Influence of Ecological Factors on the Metabolomic Composition of Fish Lenses. Biology (Basel). 2022 Nov; 11: 21709. doi: 10.3390/biology11121709.

[6] Ali MA, Hussain Y, Butt AS, Rizwan M, Munir N, Kabir A, *et al.* Examination of the Physiological and Biochemical Changes Affecting Nutritional Requirements That Occur in Different Life Stages of Fish. Biological and Clinical Sciences Research Journal. 2023 Jan; doi: 10.54112/bcsrj.v2023i1.578.

[7] Ahmed I, Jan K, Fatma S, Dawood MAO. Muscle Proximate Composition of Various Food Fish Species and Their Nutritional Significance: A Review. Journal of Animal Physiology and Animal Nutrition. 2022 May; 106(3): 690-719. doi: 10.1111/jpn.13711.

[8] Arjunsinh PN, Datta SN, Singh A, Singh P. Annual Variation in Proximate Chemical Composition of Fish Sold in Ludhiana Market: Punjab, India. European Journal of Nutrition & Food Safety. 2024; doi: 10.9734/ejnfs/2024/v16i71452.

[9] Khan NTNSJP, Laghari AJ, Memon F. Bio-Chemical Composition of Catfish, *Rita Rita* from Indus River Near Jamshoro. Pure and Applied Biology. 2017 Mar. doi: 10.19045/bspab.2016.50165.

[10] Azam SM and Naeem M. Proximate Body Composition of Talang Queenfish (*Scomberoides Commersonnianus Lacépède*, 1801) From Pakistan. Sarhad Journal of Agriculture. 2022; 38(1): 204-209. doi: 10.17582/journal.sja/2022/38.1.204.209.

[11] Hewavitharana GG, Perera DN, Navaratne SB, Wickramasinghe I. Extraction Methods of Fat From Food Samples and Preparation of Fatty Acid Methyl Esters for Gas Chromatography: A Review. Arabian Journal of Chemistry. 2020 Aug; 13(8): 6865-6875. doi: 10.1016/j.arabjc.2020.06.039.

[12] Otene BB, Gossoka PM, Ukwe IOK. Comparative Assessment of Proximate Composition of Silver Catfish (*Chrysichthys Nigrodigitatus*) and Nile Tilapia (*Oreochromis Niloticus*) From Okrika Fish Landing Site, Bonny River, Port Harcourt. Research Journal of Pure Science and Technology. 2023 Sep; 6(3): 2695-2696.

[13] Khalid M and Naeem M. Proximate Analysis of Grass Carp (*Ctenopharyngodon Idella*) From Southern

DOI: https://doi.org/10.54393/mjz.v5i04.126

Punjab, Pakistan. Sarhad Journal of Agriculture. 2018 Sep; 34(3): 632-639. doi: 10.17582/journal.sja/2018/34.3.632.639.

[14] Iqbal R, Naeem M, Masud S, Ishtiaq A. Effect of Graded Dietary Protein Levels on Body Composition Parameters of Hybrid (*Labeo Rohita and Catla Catla*) from Pakistan. Momona Ethiopian Journal of Science. 2020 Jun. doi: 10.17582/journal.sja/2020/36.2.548.558.

[15] Gul S, Hasan Z, Khan GN, Gul S, Attaullah A. Proximate Body Composition of Five Commercial Fish Species of Family Cyprinida Commonly Consumed in Swat Khyber Pakhtunkhwa Pakistan. Journal of Entomology and Zoology Studies. 2017 Jan; 5(3): 1255-1257.

[16] Kousar A, Naeem M, Masud S. Effect of Different Dietary Levels of Protein on the Proximate Composition of Genetically Improved Farmed Tilapia (GIFT) From Pakistan. Sarhad Journal of Agriculture. 2020 Jun; 36(2): 373-374. doi: 10.17582/journal.sja/2020/36.2.517.525.

[17] Khekare SS and Sawane AP. Nutritive Evaluation of Some Small Indigenous Fishes from Warora Taluka, (MS) India. Online International Interdisciplinary Research Journal. 2019 Aug; 6(1): 47-52. doi: 10.19045/bspab.2016.50165.

[18] Bano S, Naeem M, Masud S. Effect of Different Dietary Protein Levels on Proximate Composition of Labeo Calbasu from Pakistan. International Journal of Biology, Pharmacy and Allied Sciences. 2019; 8(11): 2095-2103. doi: 10.31032/IJBPAS/2019/8.11.4855.

[19] Mitra T, Das D, Halder A, Sarkar S, Banerjee S, Bhowmick S, *et al*. Nutritional Composition of Different Size Groups of Catfish *Rita Rita* (Hamilton, 1822) From River Ganga. Indian Journal of Fisheries. 2017; 64: 76205-10. doi: 10.21077/ijf.2017.64.special-issue.76205-10.

[20] Naeem Z, Zuberi A, Ali M, Naeem AD, Naeem M. Effect of Body Size and Condition Factor on Proximate Composition of Clarias Batrachus Under Different Concentration of Ammonia. Momona Ethiopian Journal of Science. 2024 Sep; 16(2): 315-30. doi: 10.4314/mejs.v16i2.9.